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INTERCENTRA AND HYPAPOPHYSES IN THE CERVICAL REGION OF MOSASAURS, LIZARDS, AND SPHENODON.

HENRY FAIRFIELD OSBORN.

IN the course of a recent study of the skeleton of Mosasaurs[1] I was much struck by the uncertainty which prevails in the interpretation of the elements entering into the vertebræ of the neck. The leading American authorities, Cope, Baur, and Williston, differ widely in their descriptions of these parts in different papers. The late Professor Baur himself had a perfectly correct notion of the components of the neck, as I learned from him in conversation; but a clear statement of his views is not to be found in his published writings. Two of the leading German comparative anatomists, Gegenbaur and Wiedersheim, fail entirely to recognize clearly the very interesting structure of the cervical vertebræ. I was thus led to the comparison of the neck vertebræ in different members of the Squamata and Rhyncocephalia, with most interesting results.

It appears that *intercentra are present in the neck of all*

[1] A Complete Mosasaur Skeleton, Osseous and Cartilaginous, *Mem. Amer. Mus. Nat. Hist.*, vol. i, pt. iv. October, 1899.

Mosasaurs, lizards, and Sphenodon, either in a primitive position or secondarily modified to subserve a variety of functions.

The best known modification is in the atlas, where the intercentrum forms the base of the ring. The modifications which have not been so generally recognized are in the axis and the other cervicals, where the intercentra secondarily function as *hypapophyses*, while still remaining more or less distinct from the centra proper.

The primitive relations of the intercentra and pleurocentra (or centra proper) in the axis and atlas are beautifully shown in

FIG. 1.—*Platecarpus coryphæus* Cope, Coll. American Museum Natural History. Atlas, 1; axis, 2; third cervical, 3. Right neural arch, *n.a.*, in place; left neural arch removed, exposing odontoid (supposed pleurocentrum of atlas), *od.* loosely articulated with axis. Intercentrum of atlas, *i.1*; intercentrum of axis, *i.2*; intercentrum of third cervical, *i.3*; intercentrum of fourth cervical, *i.4*. Intercentra 3 and 4 are secondarily shifted forward upon the hypapophyses of the centra in front.

the accompanying photograph (Fig. 1), taken from the neck of a specimen of Platecarpus — one of the Kansas Mosasaurs. But before describing this it will be well to recapitulate.

The prevailing interpretations of the neck components in different types of reptiles are as follows:

1. *Proatlas.* The pair of small dorso-lateral elements in Rhyncocephalia (see Fig. 4, *D*), certain Lacertilia, Crocodilia,

Dinosauria, Pterosauria, Chelonia, are regarded by some authors as vestiges of a "proatlas" or degenerate vertebra between the atlas and the skull. As remarked by Baur, these pieces correspond in position with the "neurapophyses" of a typical vertebra.

2. *Atlas.* The lateral pieces of the atlas proper are by all authors regarded as neural arches or "neurapophyses" (*n.a.* in our figures).

3. *Atlas.* In his early papers Cope — in fact, when he first defined the "intercentrum" — regarded the ventral pieces of atlas and axis as "intercentra" (*i.1* and *i.2* in our figures). The

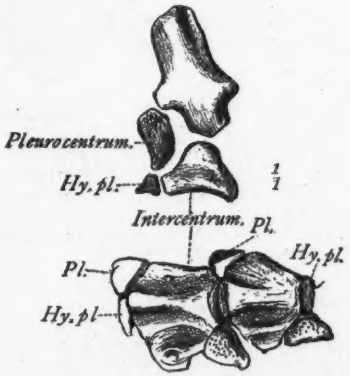

FIG. 2.— *Chelydosaurus vranii* Fritsch. A rachitomous amphibian vertebra from the Permian of Bohemia, viewed from the *right* side, after Fritsch. Neurapophyses, neural arch, 2 pieces; pleurocentra, on sides of notochord, 2 pieces; hypocentrum pleurale, below notochord, 1 piece; intercentrum arcale, below notochord, 1 piece.

anterior ventral piece (*i.1*), or lower element of the atlas ring, is, however, described as a "centrum" (*i.e.*, "pleurocentrum") by Baur in his latest paper; by Gegenbaur as possibly an "hypapophysis" (*Vergleichende Anatomie*, 1898, p. 249). In an unpublished lecture chart Baur rightly interprets ventral pieces of both atlas and axis as "intercentra."

4. *Axis.* The odontoid process is regarded as the pleurocentrum or centrum proper of the atlas, which has become secondarily attached to the axis (*od.* in our figures).

5. *Axis.* The posterior ventral piece (*i.2* in our figures) is described as an "intercentrum" by Baur, as the "atlantar hypapophysis" by Williston, in the Mosasaurs.

6. *Cervicals 3–9.* The ventral intermediate pieces (*i.3* to *i.8* in our figures) are spoken of as "intercentra," also as "hypapophyses."

1. RACHITOMOUS PROTOTYPES.

For the origin of these structures we must naturally turn back to extinct forms, and we find two rachitomous prototypes — one composed of six pieces, one of five.

Among the primitive Amphibia (Stegocephalia) we find types in which every vertebra is composed of six pieces, as figured by

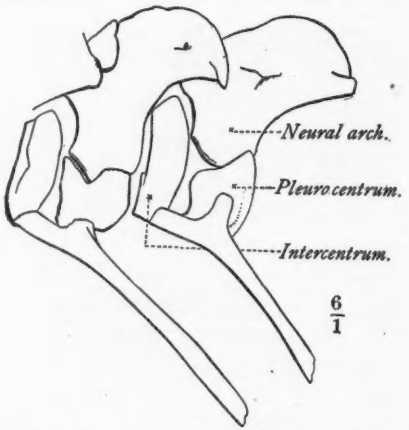

FIG. 3. — *Dicœsaurus* Credner. A rachitomous amphibian vertebra from the Permian of Saxony, viewed from the *left* side, after Credner. Neurapophyses, neural arch, 2 pieces; pleurocentra, lateral, 2 pieces; intercentra, median ventral, 1 piece.

Fritsch, Fig. 2 (*Chelydosaurus vranii*). It is possible, therefore, that the "proatlas" may represent, not a separate vertebra, but part of the atlas of a persistent rachitomous type.[1] This is improbable.

[1] According to this hypothesis, *for which at present little can be said*, the homologies would be as follows:

Atlas Components.	*Secondary.*
Primitive neurapophysis	= proatlas.
Primitive pleurocentrum	= neural arch.
Primitive intercentrum	= base of atlas ring.
Primitive hypocentrum pleurale	= odontoid process.

The demonstration of a vestigial, anterior, cervical nerve belonging to the degenerate "proatlas" vertebra would be fatal to the above hypothesis.

A likelier rachitomous prototype is that afforded by Discosaurus Credner, another Stegocephalian, in which it is seen (Fig. 3) that the intercentrum is in front of its corresponding pleurocentrum or centrum. Such a vertebra consists of five pieces. If from such an atlas prototype the pleurocentrum (*pl.*) were to be transformed into the odontoid process, the first result

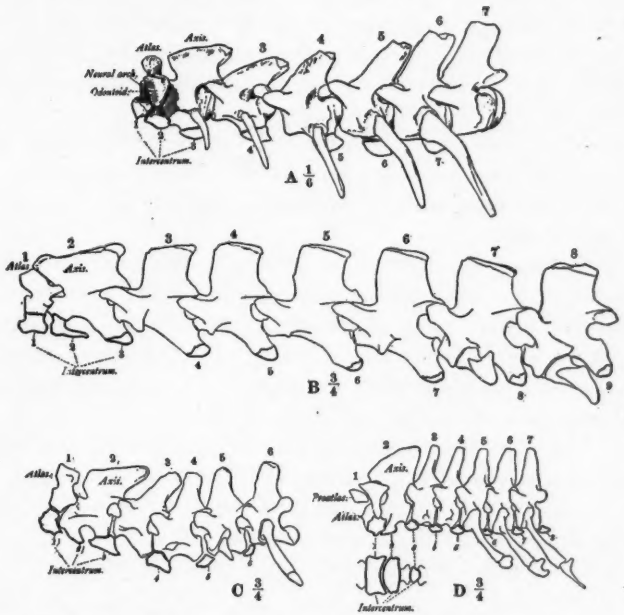

FIG. 4. — Typical cervical vertebræ of Mosasaurs, lizards, and Sphenodon. *A*. Platecarpus, a Mosasaur, with left neural arch of atlas removed. *B*. Varanus, a monitor lizard, with intercentra secondarily shifted to tips of hypapophyses. *C*. Cyclurus, a lizard, with intercentra in *primitive position*, excepting *i.2*, which has been shifted backwards and coalesced with hypapophysis of axis. *D*. Sphenodon, a Rhyncocephalian, with all intercentra in primitive position, excepting *i.2*, which is coalesced with axis, as in Cyclurus.

would be to bring the atlas and axis intercentra together without change of form. This is exactly what we find in Platecarpus, one of the Kansas Mosasaurs (Fig. 1). The photograph represents a condition in which the intercentra 1 and 2 are alike in their wedge-shaped form, and are still entirely free from the other elements of the atlas and axis (see also Fig. 4).

2. CONDITIONS IN THE MOSASAURS, LIZARDS, AND SPHENODON.

The modifications of the primitive type, in which each centrum has an intercentrum below and in front of it, are well illustrated in the accompanying diagrams (Fig. 4).

The condition of the Platecarpus axis and atlas is even more primitive than that of Sphenodon; but Sphenodon is more primitive than Platecarpus in the vertebræ behind the axis.

A. In Platecarpus both atlas and axis intercentra free and wedge-shaped. Intercentra 3–7 shifted forward secondarily upon the short hypapophyses of centra 2–6.

D. In Sphenodon a "proatlas"; intercentrum 1 of atlas loosely connected with neurapophysis of atlas; intercentrum 2 of axis completely coalesced with axis; intercentra 3–7 in their primitive position.

B. In Varanus intercentrum 1 broadly connected with atlas neurapophysis; intercentrum 2, forming an anterior hypapophysis upon axis, loosely connected in young, suturally united in adults; intercentra 3+ forming tips of the long hypapophyses of centra 2+. (This hypapophysial connection of the intercentra is an advance upon that initiated in Platecarpus.)

C. In Cyclurus intercentrum 1 broadly united with atlas ring; intercentrum 2 completely coalesced with axis; intercentra 3 and 4 in primitive position, but expanding to function as hypapophyses; intercentra 5 and 6 small, in primitive position.

The secondary modifications have, therefore, been of four kinds:

1. Conversion of the atlas intercentrum 1 into the basal piece of the atlas ring by loss of its wedge-shape and broadening of its contact with the neurapophyses (*e.g.*, Varanus, Cyclurus).

2. Lateral or complete union of the axis intercentrum 2 with the anterior portion of the axis centrum (*e.g.*, Cyclurus, Sphenodon).

3. Secondary conversion of the intercentra 2+ into hypapophyses (*e.g.*, axis of *B*, *C*, *D*; axis and third cervical of Cyclurus).

4. Shifting of the intercentra 3–7 forward upon the hypapophyses of the preceding vertebræ (*e.g.*, Varanus, Platecarpus).

This history of the atlas and axis complex in the Mosasaurs, lizards, and Sphenodon may, in conclusion, briefly be summarized as follows:

1. The intercentrum of the atlas fuses with the neural arches of the atlas to form the basal portion of the ring.

2. The intercentrum of the axis fuses with the centrum of the axis to form a kind of hypapophysis.

3. The intercentra of the remaining cervicals 3–7 either remain primitive in position, or are shifted forward upon the hypapophyses of the next vertebra in front.

AMERICAN MUSEUM OF NATURAL HISTORY,
December 7, 1899.

ARRANGEMENT AND PRESERVATION OF LARGE COLLECTIONS OF HUMAN BONES FOR PURPOSES OF INVESTIGATION.

ALËS HRDLICKA.

SINCE my mention, nearly a year ago,[1] of a definite method in the care of bones which are to be utilized for investigation, I have received several inquiries as to the details of such a method. As the subject is not without importance, I think it will be useful to bring the particulars to the general attention of the anatomists.

My practical experience with bones was gained principally in the anatomical department of the College of Physicians and Surgeons, New York, and in the American Museum of Natural History, the same city; besides this, I had a chance to make observations on a number of large anatomical, anthropological, and zoölogical bone collections both here and abroad.

The remarks which follow apply only to collections of human bones, in fact, principally to large (established or prospective) collections of the bones of whites. They apply further only to a general method of the care of bones, which will easily allow any especially desirable exceptions by individual investigators, such as the treatment of the whole spinal column (Dwight), pelvis, etc.

For small collections, for anthropological and zoölogical collections of bones, probably the best general rule is to keep, in appropriate series, all the bones of each skeleton together, minus the skull. Each bone should bear the number of the skeleton. The skulls of the same tribe of people or species of animals are kept together, heading the series. Each distinct group of skulls and skeletons in a collection is divided and arranged in at least three groups: the children or young,

[1] Before the Association of American Anatomists, New York, December, 1898, paper on Tibia.

and grown individuals, separated into males and females. In large series the embryos, adolescents, and very old may be advantageously separated from the others. The best way to preserve these collections is in tiers of sliding shelves or drawers. The anthropological collection as a whole is arranged on the basis of race and type, and further subdivided according to the geographical distribution. A zoölogical collection is naturally best arranged on the basis of the grade of evolution of the animals. This rule may be followed from the most comprehensive zoölogical subdivision to individuals.

The method of arrangement in large collections of human bones of a comparatively homogeneous character, such as the bones of whites, when the object of these collections is to be a possibility of a thorough investigation on the bones, must differ from the above.

Anatomy is past the stage of study of single normal bones, just as it is past the stage of study of any single normal organ in the body. The present and future anatomical investigations can only deal with large numbers of specimens. The points which are to be settled by the investigations concern, in the first place, the regular changes or life history of each individual bone. We are further to learn the prevalent types of each bone and their meaning; to complete our knowledge of the more primitive, recurrent, and anomalous, and define the prospective characters of each bone; and to establish the influences on the various bones of recent as well as hereditary, normal, and abnormal characters.

In order that such studies may be possible, all the bones in our collections must, in the first place, be *identified;* in the second place, they must be *supplemented with certain data on the subjects from which they proceed;* and in the third place, the bones must be so *stored as to present the utmost facility for any study desired.*

So far no osteological collection of which I have any knowledge comes fully up to the stated requirements; the collection that comes nearest to the desired standard is in all probability that of Prof. Geo. S. Huntington, in the College of Physicians and Surgeons, New York City. However, as the value and

promises of advanced investigation on bones will receive, which they cannot fail to do, a more thorough appreciation by the teachers and students in anatomy, old bone collections will increase and new collections will be established, and both these effects should take place only on the basis of the most approved principles.

Such were the considerations which led me in formulating, during the last four years, the system of care of bones, which follows. Every point advocated I had the occasion to test or observe in practice, and only that is included which is simple, practical, and essential for investigation. Some of the details which at first may seem superfluous will be appreciated later by the student of the collection. The method once tested under different circumstances in practice will undoubtedly be found capable of advantageous modifications, but I think it will, in general, prove sufficient for the beginning of a collection. . . .

The *care of bones*, when their full scientific utilization is in view, should begin at the reception of the body in the anatomical department.

It is very advisable, on receiving the body, to ascertain the following points, namely: color, sex, age, nationality (if American, the nationality of parents in addition), and last disease; also the principal (not necessarily the last) occupation of the individual in his life.

In all accidental or sudden deaths the weight of the body, with a note as to loss of blood, should be taken.

A few selected, simple measures of the body[1] and head are very desirable.

All the data, if *carefully* obtained, will serve as valuable bases for future studies and comparisons on the skeleton.

It is best that one of the permanent associates in the anatomical department of a college should be given the care of all these preliminaries.

[1] Length of the body: middle of the soles to vertex; maximum length and width of the head, with its height from biauricular line; antero-posterior and lateral diameters of the chest, at the level of the sternal articulation of the third ribs and at that of ensiform cartilage. Vertex-coccyx length is also a desirable measure.

All records should be preserved in a special book. Each case receives its number; it is best to carry the numbers on consecutively, for that will, among other advantages, facilitate references.

The number a body has been given and the year when received, are stamped indelibly on a card, and this is so attached to the body as not to be lost. When the body comes on the dissecting table, various means may be used to keep the subject identified. In all cases it is well to preserve the original card secured in some way at the table.

While the body is being dissected, care must be exercised that the different parts are not displaced. As soon as any long bone, or the scapula, or innominatum, sacrum, lower jaw or skull, is finished with, it should be the duty of some one in the dissecting room to attach by wire a little metal tag to it, with stamped-in number of the subject (zinc, or zinc-lead alloy wire and metal are to be used; steel wire will not last, while copper wire will color the bone).

All the short bones of each group (hand, foot, sternum and ribs, vertebral column) are placed into a small-mesh zinc wire cage, or into a small net (which latter, however, should be strong enough to resist boiling or maceration), and to each cage or net a similar metal tag is appended as to each larger bone.[1]

The tags are to stay on all the bones to which they were attached individually. On the short bones, when prepared and dried (which latter should be done with the bones still in their sacks or cages), the number of the subject is placed in indelible ink.

Chemicals should be avoided in the preparation of bones for study, as they affect the bone weight and specific gravity, both valuable points for investigation. Too long boiling is also injurious, particularly to the bones of the young or old.

The problem of *storing* prepared and marked bones is of considerable importance. It presents several distinct points to which attention must be directed, namely: (1) the bones should be stored so as to be protected against dust, sunlight, and

[1] System successfully used at the College of Physicians and Surgeons, New York.

great changes of temperature or moisture, and occasionally also against insects or rodents ; and (2) the bones should be stored in such a way as to be readily and easily accessible and offer the utmost facilities for study or exhibition, as well as an ease of proper replacement. These desiderata can be accomplished as follows:

1. A fairly well lighted, dry room is lined with shelve frames, or drawer frames. Other similar frames can be placed across parts of the room when necessary. The frames are so arranged that the drawers or boxes which are to be placed in them can slide in and out (this can be arranged quite simply and inexpensively). The size of the frames is determined by the size of the boxes or drawers, which must be of two or three dimensions. A very good preventive against insects, or even rodents, is a little of paris green mixed with some sugar and flour.

2. For the small bones it is best to provide light boxes just a little larger than necessary to contain their groups (speaking of adults). Low partitions (potter's clay) in these boxes would enable us to subdivide each group of small bones and much facilitate their study. A definite number of coverless boxes fit into a drawer, on which are plainly and indelibly marked the character and number (x–x) of the contents. It is best to have the drawers just large enough to accommodate the boxes with all the small bones of each individual skeleton, and to keep these bones permanently together.

The long bones may be stored in two ways, each of which has certain advantages.

All the long and other bones of the skeleton, remaining after the disposal of short bones as outlined above, minus the skull and lower jaw, can be placed together in a special drawer, which can then be placed, properly marked, next the drawer with the short bones of the same skeleton. Thus, all the bones of each skeleton, minus the skull, which can easily be found, are kept close together.

When very large series of bones are to be studied, the following method of storage is preferable: More spacious drawers are provided; or there may be simply shelves with closed

compartments, each of which has a door that ought to open downward. The bones are stored into these compartments according to the kind and side, and in series of consecutive numbers. Each large bone in the body has its own section of the shelves. The size of each section may be calculated on the basis of the space necessary to accommodate five hundred, one thousand, or a larger series of specimens. The kind and numbers (x–x) of bones are marked in this case (because changes will take place in the number or quality of the exact contents, *v.* below) preferably on cards, which are nailed or otherwise attached to the drawers.

The skulls, including lower jaws, it is best to store separately, in drawers accommodating a certain number each, and carrying in a prominent place a record of their contents.

So far for simple *preliminary* storing. The next step in arranging a large bone collection is the separation of each series of bones into three subseries, containing the normal, pathological, and anomalous bones.

The normal bones should be further subdivided according to sex (which is also applicable to the other subseries, if large). A still further advantageous subdivision of the series of bones, but only in the largest collections, is that based on racial (nationality) character of the bones.

The bones of children, and those of negroes (unless plentiful) and rare subjects, are best kept separately, a large box being provided for each skeleton.

When an anomalous or pathological bone or bones are removed from a series, a card should be kept with the series of the location of the specimens.

To complete the value of a bone collection, a card catalogue is a necessity. This may be conducted with various degrees of thoroughness. The simplest catalogue is that where each skeleton receives one card, on which are stated the history of the body (copy of the record made before dissection) and the main pathological or anomalous conditions observed on the skeleton. The ideal and most complete catalogue would be that where *each bone* would receive a card, which would bear its special characters and its dimensions.

The arrangement of specimens for *exhibition* differs much from that for storage. It should be based on at least two principles, namely: The normal bones should be arranged in series showing all their variations, the pathological and anomalous bones in series showing as many grades or steps as possible in the evolution of their specific characters. The series are arranged according to the order in which the bones of the human body are generally treated in anatomical works or lectures. Wherever possible, the series should be supplemented by casts or pictures and by specimens from lower mammals, fit for comparison. Explanatory labels with references, and, if possible, with a special card catalogue for the museum, complete the value of the exhibitions.

NEW YORK, 106 East Seventy-first St.

ON THE CORRELATION BETWEEN GROWTH AND FOOD SUPPLY IN STARFISH.

A. D. MEAD.

In the higher vertebrates there is a pretty constant relation between the age of an individual and its size, at least up to the time when the full stature is reached. This relation is expressed in carefully constructed curves of growth, and it may be inferred from common observation. The healthy individual must be able, during its early life, not only to hold its own in respect to size, but also to grow; the time between meals must be comparatively short, and the nourishment assimilated must be more than sufficient merely to replenish waste tissue. Minot has shown for guinea pigs that even "any irregularity in the growth of an individual tends to be followed by an opposite compensating irregularity." "If an individual grows for a period exceedingly fast, there immediately follows a period of slower growth; and, *vice versa*, those that remain behind for a time, if they remain in good health, make up the loss (at least in great part if not always completely) soon after." "Each individual appears to be striving to reach a particular size" — a particular size, we might add, not only for the adult age but for any particular previous age.

The normal rate of growth of marine invertebrates seems not to have received much attention, and were one to inquire among longshoremen or seaside naturalists how old an eight-inch lobster is, or how long it takes a starfish to grow to a certain size or to become sexually mature, he would meet with an interesting variety of opinions and receive little satisfactory information.

Several years ago Alexander Agassiz made an estimate of the rate of growth in starfishes, which was based upon the supposition that a close relation does obtain between size and age in these animals as well as in vertebrates. The method which he

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employed was previously used by the elder Agassiz for ascertaining the age of many marine animals (*Proc. Essex Inst.*, 1863), and is explained in the following quotation from the monograph on North American starfishes:

"The young starfishes figured on this plate (Pl. VIII) were all found attached to roots of Laminaria thrown up on the beaches in the neighborhood after a storm; and from their different stages of growth, as compared with the oldest starfish raised from a brachiolarian (Pl. VI, Fig. 11), specimens of which were also found upon these roots, it is probable that the sizes here figured are one (Fig. 1), two (Fig. 8), and three (Fig. 10) years old. A considerable number of specimens were picked up in this way, and they could all be arranged into very distinct groups, representing the starfishes of the present and two previous seasons. There seemed to be no gradation from one group to another, such as we have among the young sea urchins, which, in consequence of their manner of breeding during the whole year, form series the relations of which it is impossible to determine. In this connection I would say that, by arranging the starfishes found upon our rocks into series according to their size, we are able to obtain a rough estimate of the number of years required by them to attain their full development; this I presume to be somewhere about fourteen years. They begin to spawn before that time, as specimens have been successfully fecundated which evidently were not more than six or seven years old."

During the summer of 1898 the writer had an excellent opportunity to study the rate of growth of the starfish (*Asterias forbesii*) at a floating laboratory moored in one of the estuaries of Narragansett Bay. The breeding season was short and definite, and the larvæ began to "set" the last of June.

On June 29, innumerable young starfish, about as large as the head of a pin, were discovered clinging to the eelgrass and to the rockweed and other algæ, where a few days before none could be found. A handful of the fluffy seaweed, *Heteromorpha*, bespangled with minute stars, was placed in a floating car, whose sides were encrusted with a young growth of barnacles, fresh fronds of green algæ, and delicate branch-

ing stalks of hydroids. That the little starfish found here a natural and congenial environment was evident from their healthy appearance, their quick response, and their rapid growth.

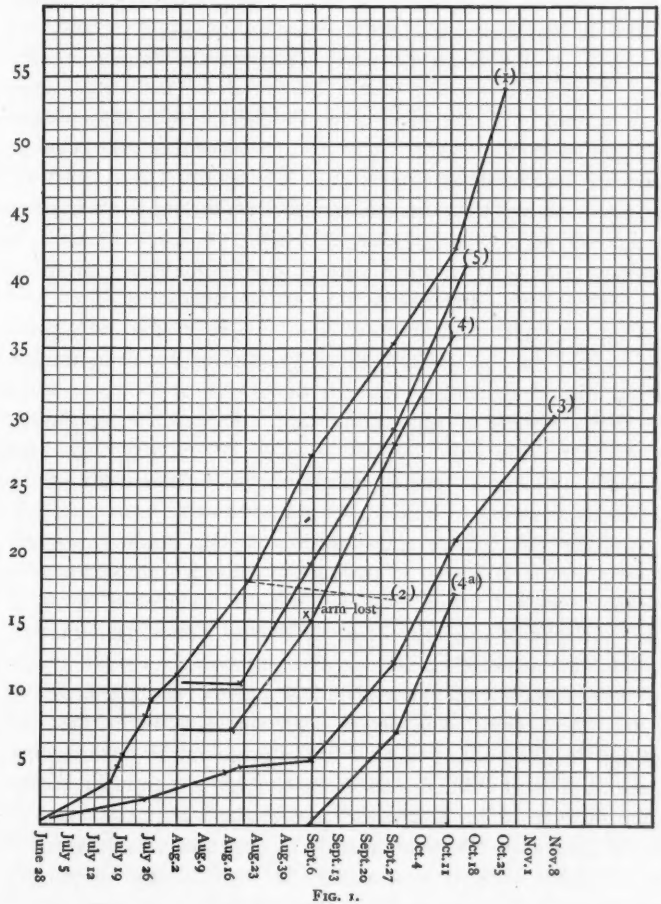

FIG. 1.

They were kept under observation until November and fed on barnacles, small clams, and mussels. As they were examined from time to time, two features of their growth were especially noteworthy, *viz.*, its rapidity and the difference in rate in

different individuals. On June 29 none of the stars measured more than 1 mm.;[1] on July 18 one of the larger specimens measured 5 mm.; July 26, 9 mm.; August 18, 18 mm.; September 26, 35 mm.; October 25, 54 mm. (over 2 inches). Curve 1, Fig. 1, is a graphic representation of the growth of these stars and is constructed from measurements of the largest specimens which could be found in the car at each observation. At any time after the first few weeks some of the specimens were three times as large as others, and between these all intermediate stages could be found. On August 18, for instance, eight specimens, arranged according to their sizes, measured 7½, 8½, 10½, 12, 13, 14½, 16, and 18 mm. A similar series — or a more perfect one — might at any time be arranged from specimens taken along the shores.

From the fact that in starfish of the same age such great differences in size exist, with all gradations between the extremes, it is evident that there is danger in applying to them Agassiz's method of ascertaining age. Indeed, the specimens which were calculated by him to be three years old were not one-fifth as large — linear measurement — as those known by actual observation to be only three months old.

Coming now to the consideration of the conditions which determine the *difference* in the rate of growth in these animals, we may exclude certain factors at once; for example, the influence of light, temperature and density of the water, and size of containing vessel, inasmuch as these conditions are practically the same for all the individuals under observation.

It appears from some other experiments, however, that difference in the amount of food is the principal, if not the only, factor. The starfish differs from the higher animals in this important respect; it can eat and *assimilate* many times as much food as is necessary merely to maintain a healthy condition. When food is accessible, the starfish eats voraciously and grows with great rapidity; but, on the other hand, it will live for months almost without food and apparently remain healthy, though it does not grow. As one watches a large

[1] All the measurements given below as "length" are from the mouth to tip of arm.

number of stars of the same age and size, transferred to a new car, he will not fail to notice that some of them happen upon a favorable food supply before the others, and in consequence grow at first much faster than the rest. Then, not only do these larger specimens have the better chance of getting food, but, if the animals usually preyed upon become scarce, the larger starfish do not hesitate to devour the smaller ones. It was noticed repeatedly that the variation in the rate of growth was much greater among the starfish whose food supply was limited than among those abundantly provided for. The immediate effect upon the rate of growth of the supplying and the withholding of food is demonstrated in the following experiments.

One of the starfishes in the car which had grown most rapidly up to August 18, when it measured 18 mm. (see curve 1), was kept until September 26 with very little to eat. During these five weeks there was no growth in this specimen (curve 2), but rather a slight decrease, although the largest specimen left in the car had doubled its length.

Another small starfish (curve 3), which was caught in the tow net as a brachiolarian and "set" in the aquarium on June 28, was kept on a very small allowance of food until July 23, when it measured 2 mm. It was then fed occasionally on small barnacles, and on September 6 measured 5 mm. After this it was given an abundance of food, with the following result: September 26, 12 mm.; October 12, 21 mm.; November 5, 30 mm.

Several other starfish which were caught in the tow and set in an aquarium at the same time with the last were kept on a small allowance until September 6, and were then apparently in good health, although they had grown but little. Fig. 2 *A* represents one of these at the age of about five weeks, and Fig. 2 *B* represents a well-nourished specimen of the same age, taken from the car.

Two specimens (curves 4, 5) of medium size, 7 mm. and 10½ mm., respectively, were transferred, on August 3, from the original car, where they had been reared on barnacles, to an adjacent car. They were supplied with a bunch of

small mussels, which, however, the starfish could not or would not open, and on August 16, after a period of thirteen days, they had not grown at all. From this time they were provided with an abundance of their usual food — barnacles — and grew with great rapidity, as is indicated in the curves. On November 12 they measured, respectively, 36 and 41 mm.

Incidentally curve 4 shows another interesting point, namely, that the loss of an arm does not cause a diminution in the rate of growth. On September 5 an arm was accidentally torn off, yet the rate of growth of the rest of the body was as rapid as

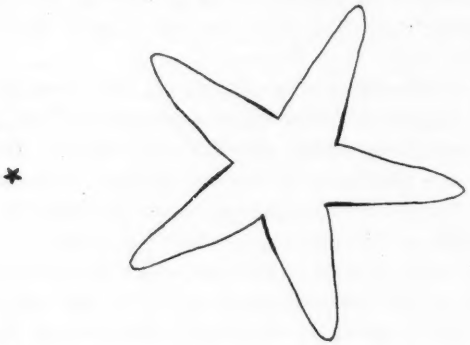

FIG. 2 *A*. FIG. 2 *B*.

These figures represent two starfishes of the same age (5½ weeks).

before, and as rapid as that of the other starfish (curve 5). The rate of growth in the regenerating member is indicated in curve 4 *a*.

The age at which the starfish becomes sexually mature also depends upon the rate of growth; in other words, a starfish must attain a certain size before it may become sexually mature. During May, the month preceding the breeding season, nearly all the starfishes measuring over 50 mm. (2 inches) are full of ripe sex products, and occasionally ripe specimens are taken which measure only 32 mm. Larvæ have been obtained by artificial fertilization from parents measuring 38 mm. Now many of the starfishes raised in the car were considerably more than 38 mm. in length on October 25, three months after

setting, and their sex glands were quite as well developed as they were in the average stars of any size at that season of the year. Allowing the very moderate estimate of 15 mm. for the growth of such individuals during the next six months, in May they would be more than 50 mm. in length, and such specimens are, with rare exceptions, sexually mature. We are warranted in inferring, therefore, that well-nourished starfishes arrive at sexual maturity and breed before they are a year old.

On the other hand, it is evident that many starfishes do not reach sexual maturity in one year, since small, immature specimens, between 10 and 20 mm. in length, are not uncommon just before the breeding season begins.

Desultory observations on other marine invertebrates, *e.g.*, the clam, oyster, and lobster, indicate that the conditions of their growth are essentially similar to those of the starfish, and to this extent substantiate the conclusion that between the higher and lower animals there are fundamental differences in the phenomena of growth.

BROWN UNIVERSITY.
November 9, 1899.

THE ZOÖLOGY OF THE HORN EXPEDITION.

E. H. EATON.

A WORK of considerable importance, which has received too little attention in this country, is Professor Baldwin Spencer's *Report of the Horn Expedition to Central Australia*, published in September, 1896. The author's conclusions regarding the affinities of the Australian fauna are of vital importance, especially concerning the Antarctica theory, and a brief reference to the expedition, with a statement of its main results, may be of interest to readers of the *Naturalist*.

The object of the expedition was to explore the country about the McDonnell Ranges, which lie just south of the tropic between 129° and 135° east longitude. Leaving Adelaide in the beginning of May, 1894, the party proceeded by rail to Oodnatta, where the journey of 2000 miles by caravan was begun. There were five specialists in charge of the different departments, besides two collectors, a cook, and men to care for the camels. Mr. Horn, who equipped the expedition, accompanied it for a part of the journey in a carriage drawn by a team of camels.

The course lay for the most part through the dry country in the great Finke Basin, or Larapinta Land. Sandy deserts, "gibber" plains, dry river channels, with occasional water holes, scanty brush, and dried porcupine grass offered a monotonous scenery and poor prospects for collecting. By day the unclouded sun drove all but the hardiest creatures from the blistering sands; at night the temperature often fell many degrees below the freezing point. A yard away from the water holes the earth was parched and unfit for the habitation of animals or plants. In this region, however, during the rainy season, there is a wonderful change of scenery. Vegetation grows with amazing rapidity. Frogs, lizards, and mollusks creep from their hiding places, and their swarming descendants soon cover the country. Fishes and crustaceans are scattered by the swollen rivers from

the water holes where they have survived the dry season. Insects increase with the vegetation on which they feed, and the region is invaded by numerous birds which find their favorite food. Even rodents and marsupials immigrate sometimes in vast numbers from the surrounding regions.

But soon this brief season is past, and only the hardiest and those with special equipment to endure the ensuing drought and extremes of temperature survive the long dry season.

There was little opportunity for collecting specimens, except for an hour or two each day, when halting for food and water. If a rare lizard were seen hurrying away as the march was proceeding, before the unwilling camel could be compelled to fall back from its companion and kneel for dismounting, the agile lizard had made good its escape. Thus, only the twenty days of "spelling" in camp out of 125 days in the field were really available for taking specimens.

Besides several orders of invertebrates which had not been worked over when the report was published, there were 603 species of animals collected by the expedition, of which 171 species were new to science. The following is Professor Spencer's table of species collected:

MAMMALIA.	NO. OF GENERA.	NO. OF SPECIES.	NO. OF NEW SPECIES.
Carnivora	1	1	0
Chiroptera	2	2	0
Rodentia	3	11	3
Marsupialia	16	24	6
Monotremata	1	1	0
Aves	83	100	5
Reptilia	33	44	12
Amphibia	4	6	1
Pisces	5	8	5
Mollusca	20	38	21
Arthropoda	229	357	117
Vermes	1	1	1
	398	593	171

Several interesting observations on the fauna and flora of the center may be noted. The characteristic plants have their sur-

face adapted to prevent the evaporation of moisture, and their seeds can survive a long exposure, but germinate very rapidly as soon as the moist season arrives. The animals are such as can travel long distances with ease, like the dingo and the kangaroo, or can subsist on the dews of early morning. Some, like the burrowing frogs and mollusks, hide away from the withering sun, and others produce eggs which will not develop until after the mud in which they have been deposited dries up.

Professor Spencer thinks there is little attempt at protective coloration, in the struggle for existence, except in a general way. Nature seems to devote all her energies to the production of eggs which will develop precociously. The young, especially of insects, seem impelled to feed ravenously, and reach maturity before the favorable season is past.

As a result of the variable seasons, many species show a considerable discrepancy in size, individuals reared in successive good seasons being unusually large, while those growing in a succession of poor seasons are small. In one species, *Phascologale cristicauda*, the length of the head and body of the smallest adult male was 136 mm.; of the largest, 220 mm. The relationship of the fauna of the center to that of the surrounding regions is one of the strongest points in determining the probable source of Australian marsupials. The author divides the twenty-four species of the center into three main groups:

1. Those of continental distribution: *Trichosurus vulpecula, Sminthopsis murina, S. crassicaudata, Perameles obesula.*

2. A larger number, characteristic of the inland portion of eastern Australia, and of the south and west: *Macropus robustus, M. rufus, Petrogale lateralis, Onychogale lunata, Lagorchestes conspicilatus*, var. *leichardtii, Bettongia lesueuri, Chæropus castanotis, Phascologale calura, P. cristicauda, Dasyurus geoffroyii, Antechonomys laniger, Myrmecobius fasciatus.*

3. Those which as far as now known are peculiar to the central region: *Peragale minor, P. leucura* (probably), *Perameles eremiana, Sminthopsis psammophilus, S. larapinta, Phascologale macdonnallensis, Dasyuroides byrnei, Notoryctes typhlops.*

Professor Spencer calls attention to the fact that there is no indication of primitive monotremes of marsupials characteristic

of western Australia, and that the monotremes and polyprotodonts diminish in importance as we pass northward and northwestward from southeastern Australia.

The birds collected range over the southern portion of the continent from east to west, with a slight preponderance of western forms. The reptiles show a marked affinity with the west and north. The Amphibia, with the exception of *Hyla rubella*, are allied to those of the southeastern portion. The fishes are related to those of the coastal districts, and not to those of the Murray River system; they probably were derived from the north. The mollusks are related to the west, and, in a slight degree, to the eastern interior. The other invertebrates in the center are too imperfectly known to furnish reliable generalizations.

As a result of his investigations, Professor Spencer draws some highly interesting conclusions in respect to the faunal affinities of the island continent and the geologic changes that have combined to establish this remarkable life here. These views, while they differ in some marked particulars from those of Darwin, Wallace, and Lydekker, are, we believe, in line with the very latest scientific developments. They may be stated briefly as follows:

1. Probably a very ancient connection with southeastern Asia, existing partly in the western and partly in the eastern portions of the island, when these were separate land masses, furnished the original inhabitants, which are represented to-day, perhaps, by such forms as Xanthomelon, Peripatus, Ceratodus, Amphibolurus, Moloch, and the families Pygopodidæ, Meliphagidæ, and Trichoglossidæ.

2. A great marine area, in which the Upper Cretaceous rocks of the Rolling Downs were deposited, completely separated the western and eastern portions and isolated the higher Steppes from the ancient region further west.

3. Across the Torres Straits a connection in late Cretaceous times with a Papuan area, and with Polynesia and the New Zealand region, accounts for the distribution of Microphyura, Acanthodrilus, and the struthious birds of Australia and New Zealand; also for the introduction of the Paradiseidæ, Megapo-

didæ, Rana, Heteronota, Physignathus, Perichæta, and from the Austro-Malayan area, and later, for the passage northward of monotremes and marsupials. The union with New Zealand was severed, and only that with New Guinea probably remained at the time when the Prototheria and Metatheria had become established on the Australian continent.

4. Perhaps in later Cretaceous times, and certainly not later than the Miocene, a union with South America by way of Tasmania and Antarctica resulted in the introduction of such forms as Gundlachia, Geotria, Galaxias, Haplochiton, Aphritis, and the Cystignathidæ, Marsupialia, and possibly the Monotremata.

5. The union of eastern and western Australia, and the formation during the Tertiary period of a great lacustrian area and of pluvial conditions in the interior, favored the development of the gigantic diprotodont and struthious forms of the Pliocene period.

6. The elevation of the coastal range barrier, which was much higher in Tertiary times than at present, prevented the free intermingling of the coastal forms with those of the inland regions.

7. The isolation of the Australian continent, by the obliteration of the land connections referred to, has preserved to a great extent its unique animal life. The union with Tasmania was doubtless severed prior to the Pliocene times, when the dingo and large diprotodonts existed in Australia.

8. The desiccation of the interior in Post-Pliocene times partly replaced and partly intensified the mountainous barrier near the coast, and combined with this to separate the desert fauna from that of the well-watered districts.

After careful study of the animals collected by the Horn Expedition, and comparison with specimens from the remainder of the continent, Professor Spencer concludes that western Australia has no claim to the title "Autochthonian," as far as the higher forms at least are concerned. He discards this term, which was introduced by Professor Tate with reference to the flora. The Euronotian region of the same author he finds made up of two well-defined areas, each of which is marked by characteristic animal forms, and prefers to divide the Australian region as follows:

1. The Torresian subregion. This is the Papuan subregion of Professor Hedley, but Professor Spencer prefers the name Torresian, as less liable to lead to confusion, and as indicating the former land connection. It includes Papua and north and northeastern Australia as far south as the Clarence River.

2. The Bassian subregion, which comprises the eastern and southeastern coast region, and Tasmania. The name indicated the route by which "the South American contingent must have passed."

3. The Eyrian subregion, including all the interior, southern, and western part of the continent. It is separated by the coastal ranges from the Torresian region on the northeast, and from the Bassian region on the southeast.

The theory of a former connection between Australia and South America by means of a great southern continental area now seems thoroughly established. Mr. Wallace thought the relationship between the marsupials of the two countries, and between several families of birds and reptiles, too general to be accepted as direct evidence. He admitted, however, that cystignathous frogs, several genera of fresh-water fishes, and one genus of snail were undoubtedly transported from one region to the other, but thinks this transportation was by means of floating ice. Mr. Lydekker, in his *Geographical History of Mammals* (1896), still maintained that the evidence was too scanty to show in what latitude the connection occurred. He admits that the discovery of dasyuroid marsupials in the Tertiary of Patagonia indicates a former communication, and he points out the importance of the determination of the rocks recently brought back by the *Antarctic* as indicating a continental area; but he thinks the presence of Australian types of rats in the Philippines "is of the utmost importance in respect to Australia receiving its mammalian fauna from southeastern Asia"; and he believes that this fauna entered the island by way of New Guinea.

Professor Spencer calls attention to the fact that polyprotodont forms decrease in importance toward the north and northeast in Australia (which is the opposite of what should be the case if Professor Lydekker's theory is the true one), and pointedly remarks that Australian rats in the Philippines do not prove

that the marsupials came from the north, any more than it proves that the fish Galaxias is an immigrant from Asia. At the same time Mr. Lydekker admits that the rats are comparatively recent immigrants, and that because of their small size they may have been introduced without direct land connection.

After reading Professor Spencer's summary of evidence, and examining an atlas of the southern circumpolar regions, one is forced to admit the extreme probability of this ancient connection of southern lands, including South America, Australia, and New Zealand. We may also add Africa, in the light of Mr. Spencer Moore's paper on the origin of the Australian flora, published in *Natural Science*, September and October, 1899.

Mr. Moore speaks of this land connection practically as an axiom of science. Dr. Moreno's publication in *Nature*, Aug. 4, 1899, of the discovery of Miolania in the Tertiary of Patagonia, also of diprotodon and other marsupials in the same deposits, adds evidence on the subject which is well-nigh conclusive.

DEPARTMENT OF ZOÖLOGY,
COLUMBIA UNIVERSITY.

A GLACIAL POT-HOLE IN THE HUDSON RIVER SHALES NEAR CATSKILL, N. Y.

HENRY FAIRFIELD OSBORN.

SOME years ago I was invited to examine a pot-hole of unusual interest, which had recently been uncovered on the east bank of the Hudson, directly opposite the town of Catskill, upon the estate of Frederick E. Church, the well-known landscape artist. At the time a number of drawings and photographs were taken, together with a few notes which may be of interest to the readers of the *Naturalist*.

This pot-hole lies at the base of a cliff of shale about seventy-five feet high, and was discovered in course of excavation of

FIG. 1.— Side view of shale cliff and pot-hole.

the shale for purposes of road-building. It was first indicated by a section of its diameter upon the side nearest to the base of the sharp cliff. It was then excavated with great care to a depth of twenty-five feet, when it suddenly narrowed from an average diameter of eight feet to a diameter of five feet, and finally it was found to terminate in a bowl about the size of a wash-basin.

The whole section for a distance of twenty feet in the comparatively soft shale exhibits the sides worn very smooth, almost to a polish. At the point of contraction the pot-hole dips into a stratum of black slate which is quite highly polished. The shale belongs to the Hudson River Series, and the slate to the Utica Slate.

The upper portion of the pot-hole was filled with shale débris which had evidently fallen from the cliff. This was followed by

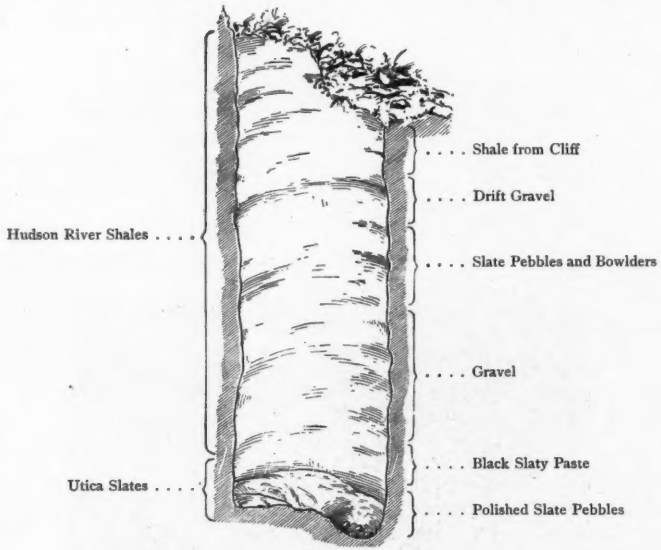

FIG. 2.

a stratum of five feet of gravel, similar to ordinary drift gravel, containing pebbles and well-rounded bowlders, varying from one inch to two feet in diameter. This was followed by a thick stratum of slate pebbles, while the lower portion of the bowl was filled with the black paste left from the wearing of the slate and containing a few perfectly rounded pebbles. There were no crevices to account for the carrying off of the stream of water which must have produced this pot-hole, and its depth indicates that it was formed in the bed of a powerful stream.

At the top of the pot-hole the face of the cliff ascends sharply,

and the surrounding sides have been uncovered so recently that we have every reason to believe the pot-hole was originally of very much greater depth than at present; and this, together with its peculiar position, renders it rather difficult to explain its origin and history. Its location is about half a mile back from the river, and the face of the cliff has a north and south direction.

In the twenty-first annual report of the Regents of the University of the State of New York on the condition of the State Cabinet of Natural History, published in Albany in 1871, is

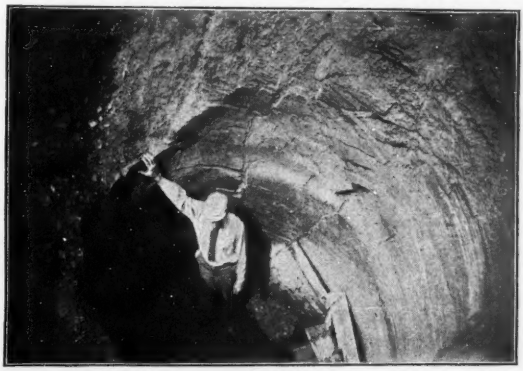

FIG. 3. — Pot-hole viewed from above, showing top of Utica slate layer where the erosion began to diminish.

found an account of the discovery of the Cohoes Mastodon by Professor James Hall. He here gives an interesting description of the glacial pot-holes in the vicinity of the present gorge of the Mohawk near Cohoes. These holes are now mostly covered by swamps and were evidently bored out from the general level. They reached a depth of from seventy to eighty feet, and their cross-sections varied from eight to thirty-five feet.

From these facts it appears probable that the Catskill pot-hole here described originally extended to the level of the top of the cliff.

Its formation was in this case similar to that which has been observed as now in process beneath some of the glaciers of Switzerland, Norway, and Sweden. In Norway they exist in

great numbers and are popularly known as "Giants' Kettles." In Oswald Heer's *Urwelt der Schweiz* we find a full description of some of the Swiss pot-holes. On the mode of formation of these holes Geikie speaks as follows: "Among the Alps, during the day in summer, much ice is melted and the water courses from the glaciers accumulate in brooks which, as they reach the crevasses, tumble down in rushing waterfalls, and are lost in the depths of the ice. Directed, however, by the form of the ice passage against the rocky floor of the valley, the water descends at a particular spot, carrying with it the sand, mud, and stones which it may have swept away from the surface of the glacier. By means of these materials it erodes deep pot-holes in the solid rock, in which the rounded detritus is left as the crevasse closes up or moves down the valley."

THE VISITORS OF THE CAPRIFOLIACEÆ.

JOHN H. LOVELL.

THE Caprifoliaceæ, or honeysuckle family, are remarkable for the variation in length of the corolla tube and the consequent adaptation of the flowers to a great variety of visitors. The wheel-shaped flowers of Sambucus contain no honey and are sparingly visited by flies and pollen-collecting bees; Viburnum, which has also a rotate corolla but secretes nectar, attracts a wide circle of bees, flies, beetles, and Lepidoptera; the corolla of Symphoricarpos is bell-shaped and visited chiefly by wasps; the funnel-formed flower of Linnæa is adapted to slender flies; *Lonicera alpigena* is a wasp flower; a part of the species of Lonicera are visited by bees in general, while others are pollinated only by bumblebees; *L. caprifolium* and *L. periclymenum* are nocturnal flowers fertilized by hawk moths; and *L. sempervirens* is pollinated by humming birds.

There are about 260 species widely distributed throughout the northern hemisphere and blooming in spring and midsummer. A few occur in South America and Australia. Their northern distribution, as well as the occurrence of fossil forms, indicates their origin in the north temperate zone. Viburnum is found in the Dakota group, which, according to Saporta and Marion, belonged to a woody and mountainous region, populated by such genera as Salix, Fagus, Populus, and Platanus, and from which southern types, especially the palms, are absent.

SAMBUCUS L.

The flowers attract very few visitors, as they contain no nectar.

Sambucus pubens Michx. Red-berried Elder.

The flower buds are at first green, changing to purplish, and finally, on expanding, to white. Cymes thyrsoid, longer than broad.

Visitors : Hymenoptera — Apidæ : (1) *Apis mellifica* L., ♀ ; Andrenidæ : (2) *Andrena vicina* Sm., ♀.

Diptera — Syrphidæ : (3) *Syrphus ribesii* L.

Coleoptera — Cerambycidæ : (4) *Pachyta monticola* Rand ; Mordellidæ : (5) *Anaspis rufa* Say. Waldoboro, May 19 to June.

Sambucus canadensis L. American Elder.

The broad, flat cymes are very numerous and conspicuous. The flowers attract very few visitors, as they contain no honey and bloom at midsummer, when they come in competition with many nectariferous blossoms. Only four species of flies have been collected, and repeatedly the blossoms were examined without observing a single visitor, and yet upon the jewel-weed (Impatiens) and the red-osier cornel, a few yards away, scores were at work. The perfume is agreeable and increases in the evening, but fails to attract crepuscular insects. The stamens are slender, surpassing the nearly sessile stigmas.

Visitors : Diptera — Syrphidæ : (1) *Mesogramma marginata* Say ; Sarcophagidæ : (2) *Helocobia helicis* Town. ; Muscidæ : (3) *Lucilia cornicina* Fab. ; Anthomyidæ : (4) *Phorbia fusciceps* Zett. Waldoboro, July.

Sambucus nigra L. Black Elder.

A variety of this species, *S. nigra laciniata* (Mill.) DC., has escaped from cultivation at Cape May, N. J. According to Knuth, the flowers of *S. nigra* are yellowish-white, honeyless, and conspicuousness is gained by their aggregation in a dense corymb. There are few visitors, partly because the strong scent is probably repellent to bees, and partly because of the absence of nectar. In the Island of Föhr, Knuth collected two flies feeding upon the pollen, and in Helgoland a single fly, *Lucilia cæsar*. In middle and southern Germany, Müller observed six flies, two beetles, and one sawfly.

VIBURNUM L.

There are fourteen species in the Northern States. The flowers are in compound cymes, which bloom in early spring or midsummer, and are white, fragrant, and nectariferous.

Viburnum alnifolium Marsh. Hobble Bush.

The inflorescence is in broad, flat corymbs of flowers of two different sizes. The center florets are small, 5 mm. broad, white tinged with red, and in autumn produce bright-red berries; while the marginal ones, a single row of which surrounds the corymb, are large, 20 mm. broad, white, and sterile. Their size has been increased at the expense of their fruitfulness, and as their use is to attract the attention of insects, they open a day or two in advance of the inner and smaller florets. "The older flowers are actually occupied," Kerner remarks, "in the allurement of insects for the advantage of the younger ones." Since their conspicuousness is useless to themselves but of benefit to the community, they may be said unconsciously to play the part of benefactors. The stamens stand nearly erect, and spontaneous self-fertilization can easily occur by the pollen falling upon the sessile stigmas.

Visitors: Hymenoptera — Apidæ: (1) *Apis mellifica* L., ☿; (2) *Bombus bifarius* Cr., ♀; (3) *Nomada maculata* Cr., ♀; Andrenidæ: (4) *Andrena sp.;* (5) *A. sp.*

Diptera — Syrphidæ: (6) *Syrphus ribesii* L.; (7) *Brachypalpus marginatus* Hunter; Muscidæ: (8) *Myiospila meditabunda* F.; Cordyluridæ: (9) *Scatophaga stercoraria* L.

Coleoptera — Elateridæ: (10) *Elater rubricus* Say; (11) *Megapenthes rogersii* Horn[1]; Cerambycidæ: (12) *Cyrtophorus verrucosus* Oliv.; (13) *Microclytus gazellula* Hald.; Œdemeridæ: (14) *Asclera ruficollis* Say; Mordellidæ: (15) *Anaspis rufa* Say; also *Pachyta monticola* Rand.

Hemiptera — two species. Waldoboro, May 9–19.

Viburnum lentago L. Sweet Viburnum.

The flowers are homogamous. The stamens are much longer than the stigmas and divergent; self-fertilization is not, how-

[1] In his list of Coleoptera from the southern shore of Lake Superior, 1896, Prof. H. F. Wickham remarks: "Of the Elateridæ it is a pleasure to record the capture of a fine specimen of *Megapenthes rogersii*, a rare insect recorded hitherto only from Canada." The specimen taken by the writer was determined by Professor Wickham.

ever, impossible, as the inflorescence often stands in such a position that the stigma is directly in line with the falling pollen. The large size of the cymes and their great abundance render the bush very conspicuous. The odor is faint but agreeable. Honey is secreted in a thin adherent layer by the ovary, but may be observed more readily in the angle formed with the corolla, where it is sought by insects.

Visitors: Hymenoptera — Apidæ: (1) *Apis mellifica* L., ☿, common; Andrenidæ: (2) *Halictus disparalis* Cr., ♀; (3) *Andrena vicina* Sm., ♀, common; (4) *A. rugosa* Rob., ♀; (5) *A. designata* Ashm., ♀; (6) *A. violæ* Rob., ♀; (7) *A. claytoniæ* Rob., ♀.

Diptera — Syrphidæ: (8) *Eristalis transversus* Wied.; (9) *E. saxorum* Wied.; (10) *Syrphus ribesii* L.; (11) *Sphærophoria cylindrica* Say; (12) *Mellota postica* Fab.; (13) *Helophilus latifrons* Loew; (14) *Syritta pipiens* L.; Empididæ: (15) *Rhamphomyia luteiventris* Loew; Muscidæ: (16) *Morellia micans* Macq.; also minute Diptera.

Coleoptera — Nitidulidæ: (17) *Carpophilus brachypterus* Say; (18) *Colastus truncatus* Rand; Cerambycidæ: (19) *Leptura lineola* Say; Scarabæidæ: (20) *Hoplia trifasciata* Say; Mordellidæ: (21) *Anaspis rufa* Say. Waldoboro, June 16, 17, 18, and 21.

Viburnum dentatum L. Arrowwood.

Honey is secreted by the lower part of the ovary, and there is a faint, rather peculiar fragrance. The stamens are 5 mm. in length and much surpass the stigmas. The flowers are not so frequently visited by insects as *V. lentago.* In addition to the list given below, two butterflies were seen at a distance upon the inflorescence.

Visitors: Hymenoptera — Andrenidæ: (1) *Halictus sp.;* (2) *Andrena rugosa* Rob., ♀.

Diptera — Syrphidæ: (3) *Syrphus ribesii* L.; (4) *Chilosia sp.*

Coleoptera — Elateridæ: (5) *Elater rubricus* Say; (6) *Sericosomus incongruus* Lec.; Cerambycidæ: (7) *Leptura chrysocoma* Kirby; (8) *L. vittata* Germ.; (9) *L. lineola* Say; Scara-

bæidæ: (10) *Hoplia trifasciata* Say; (11) *Macrodactylus subspinosus* Fab.

Hemiptera — one species. Waldoboro, July 6–10.

Viburnum cassinoides L. Withe Rod.

The structure of the flowers is very similar to that of the preceding species. The perfume is distinct, and the flowers contain honey.

Visitors: Hymenoptera — Andrenidæ: (1) *Andrena vicina* Sm., ♀; (2) *Halictus palustris* Rob., ♀.

Lepidoptera — Rhopalocera: (3) *Lycæna pseudargiolus* Boisd. & Lec.

Diptera — Syrphidæ: (4) *Sphærophoria cylindrica* Say; (5) *Syrphus ribesii* L.; Empididæ: (6) *Empis pubescens* Loew; (7) *Rhamphomyia luteiventris* Loew; Sapromyzidæ: (8) *Sapromyza longipennis* Fab.

Coleoptera — Elateridæ: (9) *Agriotes stabilis* Lec.; (10) *A. fucosus* Lec.; Lampyridæ: (11) *Telephorus fraxini* Say; Cerambycidæ: (12) *Leptura mutabilis* Newm.; (13) *Pachyta monticola* Rand; (14) *Molorchus bimaculatus* Say; Cistellidæ: (15) *Isomira quadristriata* Coup. Waldoboro, June 26–28.

In *V. pubescens* Pursh and *V. prunifolium* L. the flowers are homogamous, and spontaneous self-fertilization and geitonogamy may occur. (Robertson, *Bot. Gaz.*, Vol. XXV, No. 4.)

	Apidæ.	Andrenidæ.	Other Hymenoptera.	Syrphidæ.	Empididæ.	Other Diptera.	Coleoptera.	Lepidoptera.	Total.	Date.
V. prunifolium, Illinois, Rob. .	9	26	2	17	2	13		7	76	April 24–29
V. pubescens, Illinois, Rob. . . .	6	21		7	13	7	18	2	73	May 4–9
V. opulus, Germany, Müller . . .		1		6	1	1	7		16	
V. alnifolium, Maine	3	2		2		2	6		15	May 9–19
V. lentago, Maine	1	6		7	1	1	5	1	22	June 16–21
V. cassinoides, Maine		2		2	2	1	7	1	15	June 26–28
V. dentatum, Maine		2		2			7		11	July 6–10

An examination of the table shows that the most important visitors are Andrenidæ, flies, and beetles, to which the inflo-

rescence, with its freely exposed honey, is well adapted. The long-tongued bees are comparatively rare. The smaller bees are very efficient pollinators, and the species are both numerous and common. The absence, as a rule, of other Hymenoptera is noteworthy. Of Diptera the Syrphidæ and Empididæ are the most important. The latter are most abundant in May, the time of blooming of several species of Viburnum. Many minute flies also seek the flowers. Beetles are very frequent visitors to all the species except *V. prunifolium*, to which none are recorded. This is certainly remarkable, and further observations are desirable. Delpino included *V. opulus* among the flowers adapted to beetles, but Müller regarded flies as the most efficient pollinators. The variety of Coleoptera is interesting, as the twenty-six visits I have enumerated were made by twenty-one species. Lepidoptera are rare, as the long proboscis of these insects is not adapted to suck the honey in rotate flowers.

SYMPHORICARPOS JUSS.

There are a few flowers which are adapted to wasps, and to which these insects are very frequent visitors. The most important wasp flowers are *Epipactis latifolia* Swartz, *Cotoneaster vulgaris* Lindl., *Scrophularia nodosa* L., *Symphoricarpos racemosus* Michx., and *Lonicera alpigena* L., the last two belonging to the Caprifoliaceæ. The flowers agree in having abundant honey secreted in a short corolla, or pouch-like receptacle, about the size of a wasp's head, and usually lurid colors. In England *Epipactis latifolia* is visited by swarms of wasps, which effectually fertilize the plants, and although Darwin saw hive bees and bumblebees of many kinds constantly flying over the plants, he never saw a bee or any dipterous insect visit the flowers. He expresses astonishment that the sweet nectar should not be attractive to any kind of bee.[1] Müller's statement is very clear. He says: "This plant in the Alps often grows on the same rocks to which a wasp (*Polistes gallica*) has attached its stalked, open nests. I have found the flowers visited solely by the above-mentioned wasp, whose head just

[1] Darwin, *On the Fertilization of Orchids by Insects*, p. 102.

fits into the flower."[1] The same observer found in Westphalia five species of wasps very common visitors to *Scrophularia nodosa*. This flower exhibits retrogressive modification in that the upper fifth stamen, which is useless, is reduced to a sterile black scale.

Symphoricarpos racemosus Michx. Snow Berry.

The small reddish flowers are campanulate and pendulous. The ample supply of honey, secreted by the base of the corolla, is prevented from escaping by numerous slender hairs which line its anterior portion. The short pistil is only about half the length of the corolla, to the sides of which are attached the stamens, with the anthers converging toward the center. The flowers are homogamous. "As the wasp thrusts its head wholly into the flower, it comes at once in contact with all five anthers and then touches with one side the stigma; but on its way to the stigma little or no pollen remains attached to it, partly because the pollen is very slightly adhesive, and partly because any grains that do attach themselves are brushed off before they reach the stigma by the hairs lining the corolla."[2] But after the insect's head has been moistened with honey it acquires a plentiful coating of pollen, which is carried to the next flower.

In Thuringia, according to Müller, nine-tenths of all the visitors belong to five species of wasps; while at Lippstadt, where wasps are much less abundant, the honey bee preponderates. At Rendsburg, Schröder observed that the flowers were visited by numerous Noctuidæ between the hours of 9 and 10 in the evening; in Belgium, Macleod collected nine species of night-flying moths belonging to this family. The more important observations are given in the table[3] on the following page.

[1] Müller, *Alpenblumen*, p. 214.
[2] Müller, *Fertilization of Flowers*, p. 292.
[3] Knuth, *Handbuch der Blütenbiologie*, Bd. ii, Nr. 1, p. 527.

	WASPS.	APIDÆ.	ANDRENIDÆ.	OTHER HYMENOP.	DIPTERA.	TOTAL.
Southern Germany, Müller	7	6	2	1	1	17
Heringsdorf, Knuth	3	2				5
Brandenburg, Loew	4	2			6	12
Bremen, Alfken	2	11				13
Paris, Bonnier	3	2	1			6

Symphoricarpos symphoricarpos (*L.*) *MacM.; S. vulgaris Michx. Coral Berry.*

The greenish-white flowers tinged with rose have essentially the same structure as those of the preceding species. The stigma and anthers also mature together. In Illinois, Robertson collected, between July 8 and August 30, the following visitors: Wasps, 5; Andrenidæ, 5; Sphecidæ, 1; Pompilidæ, 1.[1]

LINNÆA L.

A monotypic genus.

Linnæa borealis L. Twin Flower.

One of the most attractive of June flowers is the twin flower, *Linnæa borealis* L., named after Linnæus, with whom it was a special favorite. It extends throughout the eastern Northern States, from Newfoundland and through British America, Alaska, Siberia, and northern Europe to England. It is a trailing evergreen vine densely carpeting the ground in cold, open woodlands. The nodding pinkish blossoms are borne in pairs at the summit of elongated peduncles, and exhale a sweet, vanilla-like fragrance. The funnel-formed corolla is five-lobed, nearly regular, though the two superior lobes are slightly larger. The tube is 8 mm. in length, and for 3 mm. is very small. The inverted position of the flower excludes rain. The lobes are whitish, the tube wine-colored, with a yellow marking on the lower side which serves as a honey guide. The honey is secreted on the same side, at the base of the corolla, between

[1] *Trans. Acad. Sci. of St. Louis*, vol. vii, No. 6, April, 1896.

the two shorter stamens. The stamens are four, included, didynamous, and the anthers dehisce introrsely. The total length of the flower is about 10 mm., of the pistil 11 mm., so that the green capitate stigma is exserted, an arrangement favoring cross-fertilization. A legitimate visitor, in creeping over the edge of the bell, comes in contact first with the stigma and deposits upon it pollen brought from another flower; subsequently, while sucking honey, the underside of its body brushes the anthers of the two longer stamens, and the head touches the anthers of the two shorter. Within the corolla are many inter-crossing hairs, which exclude small, useless flies, which I have seen vainly seeking an entrance. They also afford a foothold to the proper guests.

During a part of an afternoon a large bed of Linnæa in full bloom was carefully observed, and eight visitors were collected. On examination they all were found to belong to a single species of fly, *Empis rufescens* Loew, of the Empididæ. Other observations showed that in this locality this fly is the most frequent and perhaps the only pollenizer. In the Alps, Müller observed three Diptera and one butterfly. The butterfly was probably an accidental visitor, as these insects are unusually abundant in the Alps. Loew saw in Brandenburg a long-legged fly, *Neurigona quadrifasciata* F., of the family Dolichopodidæ. This family is closely allied to the Empididæ. The flowers of *L. borealis* L. are, then, in both continents, adapted to slender flies which live in woodlands. I saw a female bumblebee fly over a bed of the flowers without paying any attention to them. Self-fertilization may occur by the pollen falling in some instances upon the stigma.

Visitors: Diptera; Empididæ; *Empis rufescens* Loew, sucking, common. Waldoboro, June to July 6.

Lonicera.

Lonicera ciliata Muhl. American Fly Honeysuckle.

This is the only species of Lonicera native in this locality. The pendulous, funnel-formed flowers are sheltered beneath the young leaves. The tube is 10 mm. to 11 mm. long and con-

tains nectar in a spur near the base. Female species of Bombus, in their haste to obtain the nectar, frequently puncture the tube a short distance above the spur. The flowers are slightly proterogynous. The stigma usually stands a few millimeters in advance of the anthers, but in several instances I have seen it resting directly against them, so that self-fertilization may occur. The color is greenish-yellow. The flowers are visited by *Bombus vagans* Sm., ♀, and several small bees. The blooming season is from May 7 to 15.

The genus Lonicera includes about 100 species, chiefly natives of the north temperate zone. According to the visitors which pollenize the flowers, they may be divided into wasp flowers, bee flowers, bumblebee flowers, hawk-moth flowers, and bird flowers.

1. *Wasp Flowers.* — In the Alps, *L. alpigena* L. is adapted to wasps. The tube is short, with a prominent pouch-like receptacle which contains abundant honey; the entrance is protected by stiff hairs. The lower lip affords a convenient landing place. An insect comes in contact first with the stigma and subsequently with the anthers. Müller states that the flowers are homogamous, but according to Kerner they are proterogynous. The color is reddish-brown. Müller observed in the Alps 2 species of wasps in great numbers; Bombus, 3; other bees, 4; Syrphidæ, 2; Lepidoptera, 2; Coleoptera, 2.

2. *Melittophilous, or Bee Flowers.* — *L. tartarica* L. and *L. nigra* L. are visited by both the larger and smaller bees. The stigma and anthers in both species ripen simultaneously and are in close proximity; bees push their way into the flower between them and come in contact with both. Self-fertilization may occur by the insect thrusting the anthers against the stigma. *L. tartarica* is pink or white, with a tube 6 mm. long, and in Germany is visited by: Apidæ, 2; Andrenidæ, 1; Syrphidæ, 1 (Müller). Upon *L. nigra*, Apis, Bombus, and numerous smaller bees and flies have been observed.

3. *Bombus Flowers.* — The length of the tube in the bumblebee flowers varies from 3 to 15 mm., while the proboscis of the largest bees is 21 mm. long. The stamens diverge so widely that the smaller bees and flies may never touch the stigma.

Self-fertilization may occur. The color is pale yellow, or yellow.

	Length of Tube in Millimeters.	Bombus.	Other Hymenoptera.	Lepidoptera.	Diptera.	Total.
L. xylosteum, Westphalia, Müller	3– 4	2	1		2	5
L. cærulea, Alps, Müller . . .	6– 7	6	11	3	2	22
L. sullivantii, Illinois, Robertson	14–18	2	1		1	4

4. *Sphingophilous, or Hawk-moth Flowers.* — *L. caprifolium* L. and *L. periclymenum* L. are adapted to crepuscular and nocturnal Lepidoptera, especially to the hawk moths; while bees are only accidental visitors. The flowers are two-lipped and, when in bloom, stand nearly horizontal. The anthers turn their pollen-covered sides upward, and the whole underside of the moth is covered with pollen. The stigma protrudes so far in advance of the anthers that self-fertilization is not likely to occur. The honey is abundant and is secreted in the lowest part of the corolla tube, while in the non-twining honeysuckles the corolla possesses a honey-forming expansion above the base.[1] The flowers expand in the evening, when they exhale their fragrance most strongly.

L. caprifolium has a tube 30 mm. long and 1 or 2 mm. wide. The color is purplish without and white within. Müller collected upon the flowers in Westphalia: Sphingidæ, 6; other Lepidoptera, 4. The proboscis of the large hawk moth, *Sphinx convolvuli*, is 65 to 80 mm. in length. The fragrance of the honeysuckle is perceived by this moth at a long distance. Kerner removed one of these moths to a part of the garden 300 yards away from the honeysuckle and marked it with cinnabar. "When twilight fell, the hawk moth began to wave the feelers which serve it as olfactory organs hither and thither a few times, then stretched its wings and flew like an arrow through the garden to the honeysuckle." The same observer states that butterflies pass over the flowers without pausing,

[1] Kerner, *The Natural History of Plants*, vol. ii, pp. 177, 178.

and that the fragrance is either unperceived or is unpleasant to them.

The tube of *L. periclymenum* is 22 to 25 mm. long, so that the honey, which may fill the tube for half its length, is also accessible to bumblebees. During the first evening the interior of the flowers is white, and the matured anthers stand directly in front of the entrance, while the stigma is bent abruptly downward. On the second evening the color within has changed to yellow, the stigma has moved upward and stands in front of the flower, while the anthers are in turn bent downward. It is doubtless designed that moths should visit the flowers in the first stage before those in the second. Knuth was, however, unable to determine in the evening which kind of flowers was sought first, as the moths move with great rapidity. In this connection the color change is probably of not much significance. The hawk-moth flowers were once bumblebee flowers, with yellowish coloration. After the hawk moths had dispossessed the bees, the production of yellow pigment was no longer beneficial, and consequently tended to disappear. Its reappearance in the older flowers is due partly to reversion and partly to oxidation, for the flowers in wilting continue to darken and turn a dingy orange-brown. Moreover, yellow is probably as conspicuous as white in the evening, and nocturnal flowers, as the evening primrose, *Œnothera biennis*, may be yellow-colored.

On the Island of Föhr, Knuth collected: Sphingidæ, 5; Noctuidæ, 1; Diptera, 4; Bombus, 1. The same observer saw in Helgoland: Sphingidæ, 2; Noctuidæ, 2. Heinsius saw in Holland: Bombus, 1, as well as many pollen-eating flies. Macleod observed in Belgium: Bombus, 2; Sphingidæ, 1.

5. *Ornithophilous or Bird Flowers.* — *L. sempervirens* L. is fertilized by the ruby-throated humming bird. The narrow tube is 25 to 35 mm. long, with a regular limb. The color is scarlet outside, yellow within, or rarely throughout. The flower is scentless. Crimson or scarlet is the characteristic color of bird flowers, as *Lobelia canadensis* and *Tecoma radicans*. Red appears to be the favorite color in bird æsthetics, and a larger number of edible fruits display this hue than any other. Of

the fourteen species of Lonicera in the Northern States, ten have red berries, one yellow, and three black, or bluish-black. The original color of *L. sempervirens* was undoubtedly yellow, to which it occasionally reverts. This color change is very common and may occur in the course of the development of the individual flower. In certain South American species of Lantana the flowers are at first yellow, when they are visited by bees, and later change to red, and are then attractive to butterflies. *L. sullivantii* is also visited by the humming bird.

Diervilla Mœnch.

This genus is confined to North America and consists of two species; one is distributed throughout the north temperate zone, the other is found in the mountains of the Southern States.

Diervilla diervilla (L.) MacM.; D. trifida Mœnch. *Bush Honeysuckle.*

The northern species, *D. diervilla*, is a low shrub growing in rocky woodlands and thickets. The flowers are solitary or in few-flowered cymes. The corolla is funnel-formed, more or less two-lipped, with a tube 7 mm. long, light yellow, the upper lobe marked with an orange honey guide. The honey, which is abundant and may fill the tube for 3 mm. of its length, is secreted by a thick quadrangular gland at the base of the tube on the upper side. The lower portion of the filaments, style, and middle lower petal are bearded, the hairs serving to exclude small insects and the wet. The odor is very faint or absent. The older flowers turn reddish, a color change which also occurs in *Ribes aureum* and in the genera Weigelia, Fuchsia, and Lantana. In *Ribes aureum*, Müller states that the more intelligent insects immediately recognize those flowers which no longer contain nectar, and consequently visit more blossoms in the same time.[1] Repeated observations failed to show that the color change in *D. diervilla* was of the same signifi-

[1] *Fertilization of Flowers*, p. 251.

cance. The honey bee was observed to visit the red flowers both when solitary and when associated with yellow flowers. Neither was there any preference manifested for yellow flowers when flowers of both colors occurred in the same cyme. Examination showed that the reddish flowers continued to secrete honey abundantly. This is an instance, not uncommon, of a flower secreting nectar longer than is necessary. The stems and leaves are frequently reddish, due probably to oxidation, and the reddish color of the older flowers appears to be due to a similar change in the nutritive fluids.

The flowers are proterogynous. Immediately after the apices of the corolla separate, the stigma protrudes in a receptive condition. At this stage the anthers, which are 4 mm. long, rest directly against the style, the length of which is then 13 mm. and of the stamens 12 mm.; in the older flowers the style lengthens to 19 mm., the stamens to 15 mm. The anthers dehisce introrsely shortly after the expansion of the flower, but as they are shorter than the style, self-fertilization is not likely to occur. As the style lengthens it is bent aside, and the honey bee was observed to visit flower after flower without coming in contact with the stigma.

The length of the corolla tube (7 mm.) and the fact that the anthers are divergent and not in close proximity to the stigma indicate that the flower is adapted to bumblebees. The smaller bee, *Halictus disparalis* Cr., ♀, was seen to try vainly to reach the honey. The most frequent visitor, however, is the honey bee. The larva of the hawk moth, *Hemaris diffinis*, feeds upon the leaves, and the moth sucks the flowers. Minute flies and a beetle were observed feeding upon the pollen.

Visitors: Hymenoptera — Apidæ: (1) *Apis mellifica* L., ♀, sucking, frequent; (2) *Bombus bimaculatus* Cr., ♀, s.; (3) *Psithyrus* (*Apathus*) *laboriosus* Fab., ♀, s.; Andrenidæ: (4) *Halictus sp.;* (5) *H. disparalis* Cr., ♀, collecting pollen; (6) *Halictulus americanus* Ash., ♀; (7) *Augochlora aurata*, Sm., ♀, c. p. None common except the first.

Lepidoptera — Rhopalocera: (8) *Pamphila peckius* Kirby, s.; Heterocera: (9) *Hemaris diffinis*, s., standing on a leaf or poising on the wing. June 29 to July 6. Waldoboro.

Weigelia Thun.

The eastern Asiatic species of Weigelia are often referred to Diervilla, but are regarded as distinct by Britton.[1] An immense number of varieties have been produced in cultivation by selection and hybridization, which are remarkable for their wide range of coloration. There are white and deep-red forms with every intermediate shade; white when opening but changing to rose; deep red in bud but rose-colored in bloom; flower pale rose at first, changing to deep red; yellow; light yellow, changing to white; pale yellow, changing to pale rose; and reddish-purple. The leaves are also frequently highly variegated with yellow and white.

Weigelia rosea Lindley.

The trumpet-shaped flowers were observed by Müller in Germany to be visited by *Osmia rufa* L., ♀, and also by *Halictus leucopus* K., ♀, and *H. sexnotatus* K., ♀. These small bees creep into the corolla tube, the mouth of which is 8 to 10 mm. in diameter, to obtain the nectar. They come in contact first with the stigma, which surpasses the anthers, and then with the pollen-covered anthers. The flowers are stated to be proterogynous, but not to the exclusion of self-fertilization. Knuth saw *Bombus agrorum* F., ♀, frequently visit the flowers in his garden. There is not, however, sufficient room for the larger bees to enter the flower conveniently.[2]

[1] Britton and Brown, *Illustrated Flora*, vol. iii, p. 242.

[2] Knuth, *Handbuch der Blütenbiologie*, Bd. ii, Nr. 1, p. 525.

REVIEWS OF RECENT LITERATURE.

ANTHROPOLOGY.

Anthropological Notes. — In the *American Anthropologist* for July, Dr. J. Walter Fewkes describes the Alósaka cult of the Hopi Indians. His conclusions are, in part, as follows: "There survives in the Hopi Ritual a worship of horned beings, called Alósakas, which once existed at the now ruined pueblo of Awatobi." "The purpose of the rites performed in this cult is to cause seeds, especially corn, to germinate and grow, and to bring rain to water the farms." "The Alósaka cult is a highly modified form of animal totemism, and the Alósaka represents the mountain sheep."

Professor A. C. Haddon publishes an account of the Cambridge Anthropological Expedition to Torres Strait and Sarawak in *Nature* of August 31. It is stated that the scientific results obtained by the seven members of the party will be published in a series of memoirs which will be obtainable separately. Dr. Rivers and Messrs. Myers, McDougall, and Seligmann will write the volume on experimental psychology; Mr. Ray is said to have ample matter for a volume on linguistics. Professor Haddon will deal with the physical anthropology of the natives of Torres Strait and New Guinea. Music, religion, medicine, statistics, architecture, etc., will be treated by the several members of the party. A large number of excellent photographs were taken.

An illustrated article appeared in the July number of *Monumental Records*, in which Mr. Geo. H. Pepper described the ceremonial deposits found in an ancient pueblo estufa at the Pueblo Bonito in the Chaco Cañon. The Hyde Expedition, of which Mr. Pepper is the director, has worked several seasons at that extensive group of ruins, and the explorations are to be continued. The discovery of ceremonial objects is said to be the first reported from any pueblo ruin.

In the September-October number of the *American Antiquarian*, William P. Blake publishes a brief account of the aboriginal turquoise mines of Arizona and New Mexico. He mentions a few of the localities from which turquoise has been obtained, but refers the reader

to the treatise, by Geo. F. Kunz, on "Gems and Precious Stones of North America," for further information. The author maintains that the Nahuatl term "chalchuitl" referred to turquoise and not to jade and emerald, as stated by E. G. Squier. We note that Brinton, in his "Prehistoric Archæology," applies the term "chalchuitl" to jade alone.

In the same journal A. F. Berlin describes a valuable collection of terra-cotta antiquities from the land of the Incas, and incidentally mentions the fact that these rare specimens had been safely transported long distances by the careful and friendly natives, but were broken and otherwise injured by the New York custom inspectors.

The first number of Vol. I of the *Memoirs of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History* is devoted to Hawaiian Feather Work. The director of the museum, W. T. Brigham, refers to the early voyagers who found the art of feather working in a flourishing state in Hawaii during the latter part of the last century; he then describes and furnishes illustrations of the birds from which the feathers are obtained; the helmets, cloaks, and other articles of feathers are described in more or less detail, and lists are given of the specimens now known to exist in the various museums of the world. The monograph is very fully illustrated, two of the plates being in colors.

GENERAL BIOLOGY.

Physics of Cell Life. — Realizing the prematureness of any present attempt at a chemical understanding of cell phenomena, and believing that there is a large field for interpretation upon a purely physical basis, Dr. L. Rhumbler has devoted himself to a most promising line of investigation — the study of the physics of the cell as explanation of its phenomena; an attempt to analyze cell life, as far as may be, into physical components, leaving the ultimate chemical problems for the future. His previous papers deal with the shell-making of the rhizopods and with cell division; the present,[1] with some of the phenomena of distribution of pigment in eggs and early larvæ.

Assuming that protoplasm is a foam, much as claimed by Bütschli, and that the nucleus and the centrosomes at certain times absorb

[1] Physikalische Analyse von Lebenserscheinungen der Zellen II, III, *Archiv f. Entwick. d. Organismen*, Bd. ix, Sept. 5, 1899, pp. 32–100, Pl. IV.

liquids from the foam, he has argued the necessary occurrence of many of the phenomena of cell division. On the same basis he now attempts to account for the distribution of pigment in many cases.

With the aid of pressure experiments upon the yolk of the hen's egg, the use of his system of elastic bands, and of the interesting gelatine models devised by Bütschli, the author endeavors to support an application of his views to the phenomena described by Fischel in 1899. Fischel placed live eggs of echinoderms in very weak solutions of neutral red, and found that minute granules became stained all through the egg. When the egg divided, these granules were concentrated about the nucleus and in the spindle stage formed a dumbbell-shaped mass; later they were again more uniformly distributed. Rhumbler endeavors to show that this apparent motion of the granules was not due to actual migration, and then explains it as a result of the drying effect postulated in his theory. If the nucleus absorbs water from the neighboring foam, the lamellæ of that foam will become denser and the contents of the alveoli smaller, and large bodies, such as yolk spherules, be squeezed away from such a region of increased pressure. Small bodies may, however, remain, provided they have sufficient adhesion to the alveolar lamellæ. This he assumes to be the case with the minute stained granules. In the region about the nucleus, where water is absorbed and from which large granules are forced away, there will be a condensation that must bring the granules nearer together if they stick to the shrinking lamellæ. The crowding of granules about the nucleus is thus due to a diminution in mass of material and not to a migration of granules from afar.

The author next takes up the arrangement of normal pigment in the eggs of Amphibia. The well-known dark streak that marks the path passed over by the sperm moving within the frog's egg is due, he maintains, not to any attraction on the part of the sperm, nor to any manufacture of new pigment, nor to any other chemical process, but simply to the physical stress produced by the passage of a body through a foam. The sperm adheres to the foam framework and tends to pull it along; the resulting tension behind the sperm leads to outflow of the more liquid contents of the alveoli, and a shrinkage of the framework that draws the adherent pigment granules nearer together.

The pigment is thus concentrated behind the sperm much as the colored granules were concentrated about the nucleus in Fischel's experiments. The granules remain in the region of tension and

diminished volume and so are nearer together; they do not travel to such regions.

Though the reader may not be convinced of the necessity of this explanation, it is certainly most interesting to learn that bubbles of air squeezed through mashed egg masses, and even through artificial mixtures of soot and emulsions, do leave pigmented tracks behind, similar to the sperm track. Some physical explanation of the pigmented sperm track seems forced upon us.

The author then takes up the concentration of pigment upon part of the surface of the frog's egg; the aggregation of pigment about the nucleus in cleavage stages of the frog's egg; the remarkable rearrangements of pigment in isolated cells of frog's eggs when "cytotropic" movements bring them together again; the arrangements of pigment in blastulæ of triton after injury by pressure; and the normal arrangement of pigment in certain cells of the triton in the stages of gastrulation and of formation of neural ridges.

In all cases he applies the same formula: pigment collects in areas of increased pressure and of condensation.

When cells are in active chemical interchange there will be greater adhesion of their applied surfaces and less cohesion of the part of each turned towards its neighbor. The parts of the cells most removed from such interchange will be those of relatively high tension, and in these the pigment, if present at all, may be concentrated by adhering to the shrinking lamellæ. Pigment will be on the denser and chemically inactive sides of cells.

In early stages of development pigment does not indicate active chemical changes where it is found, nor is it of any direct use; it remains inert and is concentrated in areas of condensation or may even be expelled from active areas.

Secondarily, natural selection may have emphasized its occurrence in some places where it happened to be of use.

Aside from the main issue, the author's evidence that invagination and evagination are due to actions of individual cells seems specially interesting. E. A. A.

Biological Lectures. — The substantial character of the work done at the Marine Biological Laboratory at Woods Holl is evinced by the recently published volume of *Biological Lectures* for 1898.[1] The sixteen lectures thus brought together are by well-known authorities, and touch on one side or another almost all the important biological

[1] *Biological Lectures, from the Marine Biological Laboratory, Woods Holl, Mass., 1898.* 343 pp. Ginn & Company, Boston, 1899.

problems of the day. The opening lecture is on the structure of protoplasm, by E. B. Wilson, whose study of the living echinoderm egg has led him to revise his former opinion and declare himself now in favor of the alveolar structure of protoplasm. Too much stress cannot be laid upon the importance which the author ascribes to the study of living protoplasm as a check upon what we assume to be a satisfactory preservation of it by histological means. Five lectures deal with problems of cell lineage: the homologies of cells and cell groups are discussed by E. B. Wilson; the interpretation of the various kinds of egg cleavage as adaptations of the egg is taken up by F. R. Lillie; the importance of protoplasmic movement in the distribution of materials from the nucleus is emphasized by E. G. Conklin; equal and unequal cleavage in annelids is treated by A. L. Treadwell, who points out that those organs which appear early in ontogeny are usually represented by large-bodied cells, irrespective of the distribution of yolk; the origin of the prototroch is considered by A. D. Mead. Closely related to these subjects are C. M. Clapp's lecture on the relation of the axis of the embryo to the first cleavage plane, which is dealt with from the modern experimental standpoint, and T. H. Montgomery's account of the nucleolus. The possible relations of contractility and phosphorescence are pointed out by S. Watasé, who argues for the view that phosphorescence may be a general property of living protoplasm. T. H. Morgan, in considering some of the problems of regeneration, points out the apparent inefficiency of purely mechanical explanations, and suggests to students the importance of keeping the vitalistic standpoint in view. Problems in evolution are represented by H. C. Bumpus's interesting examination of a large number of English sparrows killed in a severe winter storm; the birds eliminated were in one respect or another far removed from the typical form. The question of heredity is dealt with by J. Loeb, as illustrated in the markings of fish embryos, and the present necessity of an analytic treatment is enforced. Paleontology is represented by W. B. Scott's account of North American ruminant-like mammals. An appreciative historical review of Wolff's *Theoria generationis* is given by W. M. Wheeler. Animal psycho-physiology is represented by W. W. Norman's very interesting paper on the question whether the reactions of lower animals due to injury indicate sensations of pain, and C. O. Whitman's elaborate account of the habits of leeches, salamanders, and pigeons. The volume is concluded with brief memorial notices of J. I. Peck, J. E. Humphrey, and W. W. Norman.

G. H. P.

ZOÖLOGY.

Kingsley's Vertebrate Zoölogy. — That the study of vertebrate anatomy in America has passed the period of pure comparison and entered that of a more scientific morphology has become evident by the appearance of a recent work by Dr. John Sterling Kingsley,[1] who thus gains the honor of producing the first American text-book on the subject.

By this we do not mean that there has been any lack of special investigation in the field of vertebrate anatomy, but, as stated in the preface of the work under consideration, "observation and uncorrelated facts do not make a science," and a comprehensive text-book which collects in a system the results of this series of investigations has hitherto been lacking in our literature. The place of such a work has been supplied up to the present time by European text-books, among which may be first mentioned the *Grundriss* of Wiedersheim (latest edition 1898) and the new edition of Gegenbaur, of which the first part has just appeared; but in these the disadvantage of a foreign language, the lapse of time which must necessarily ensue before they can appear in translation, and the exotic character given by the frequent references to animals exclusively European emphasize the need of an American manual illustrated by American material. In this respect it becomes a matter of satisfaction to glance through the pages of Kingsley's work and find Acanthias, Necturus, Amblystoma, and Sceloporus in place of Scyllium, Proteus, Salamandra, and Lacerta.

The object of the book, as stated by the author, is "to supplement both lectures and laboratory work and to place in concise form the more important facts and generalizations concerning the vertebrates," and its employment as collateral reading for the student will emancipate the lecturer from the necessity of continually reiterating the elementary principles of the subject. Its use in the laboratory, also, where it will assist the student in finding out what he wishes to know, will be a pleasing change from the usual laboratory manual, with its too carefully tabulated series of observations, a style of literature which it is as easy for an author to write as it is difficult for another to follow.

In arrangement Dr. Kingsley's text-book is divided into two parts,

[1] Kingsley, J. S. *Text-Book of Vertebrate Zoölogy.* New York, Henry Holt & Co., 1899.

the first being morphological, and the second systematic. In the first part the work is based entirely on embryology, and an introduction which sketches the main features of development is succeeded by the morphology of the organs arrayed in accordance with the germ layers. Although logically there is much to be said in favor of such an arrangement, it would seem hardly an improvement on the usual method, which begins with the skeleton and muscles, and thus presents a framework that may serve as a series of relations by means of which the other systems may be more easily described. Although permissible for an elementary text-book of general morphology where there is little or no descriptive anatomy, it would not seem possible to employ such an arrangement in a work upon the anatomy of a single animal, for historically the nomenclature of the bones was the first established, and organs and parts of organs have been named with reference to these, or to other parts which, in the usual order, precede them. A second difficulty is that it is impossible to remain consistent to such a plan, or if strict consistency be carried out, it is then necessary to separate most widely organs which should be treated together. Thus, in the treatment of gills (p. 22), it becomes logically advisable to speak of the external "gills" of amphibians which are strictly ectodermic and which, with due regard to the arrangement of the book, should come in with the integument (about p. 90). Again, scales are treated under the division "ectodermal structures," but these include the scales of teleosts which, in their completed state, are entirely mesenchymatous, and also the scales of Selachians which possess a double origin. The subject of teeth, though strictly homologous with the latter organs, appears with the "endodermal organs," although their origin is made clear in the text, while dermal or membrane bones are treated under "skeleton." It is of course impossible by any arrangement always to bring correlated parts into close juxtaposition, but an arrangement which separates so widely three such closely related structures as placoid scales, teeth, and dermal bones is certainly unfortunate.

In the arrangement and nomenclature of the embryonic layers, the author has employed the very convenient terms "mesothelium" and "mesenchyme" for the two structures which arise between ectoderm and endoderm, and thus leaves the word "mesoderm" to be employed as a comprehensive term for both structures. It remains to be seen, however, whether the replacement of the terms "invagination" and "evagination" by the Saxon "inpushing" and "outpush-

ing" will be more favorably received than have been the many attempts to find a substitute for the German "Anlage."

The verbal nouns referred to must imply such verbs as "to inpush" and "to outpush," and these forms are, as a matter of fact, employed, as, for instance (p. 19), "becomes inpushed into the deeper layers," but upon the same page the expression "pushed inside" and also the noun "ingrowth" appear, thus causing some confusion.

A characteristic which impresses one especially favorably is the extreme conciseness and concentration shown in the entire work, which, at the same time, does not prevent the description from being more than usually clear and comprehensive. An especially good illustration of this is seen in the morphological description of the skull, in which the entire subject is covered within the limits of seventeen pages, and yet every essential point is fully treated (pp. 150–167).

The second part of the work is called the "Classification of Vertebrates," but in reality it gives not only the enumeration of the groups, but also presents so many anatomical details that it may be used as a special comparative anatomy filled with the details which were not possible in the first part. Thus, if a student is in search of a special point in the anatomy of any animal, he should first read the morphological description of the organ as given in the first part, and then turn successively to the descriptions of the class, order, and the smaller subdivisions within which the animal in question is found. This seems an excellent arrangement and may be the cause of the extreme conciseness of the first part, as it avoids clogging the exposition of the theories with concrete examples, as in the majority of the text-books on the subject. Especially noticeable in the second part is the treatment of the reptiles, which are completed by the addition of the fossil orders; and that of birds, which gives the new classification founded upon anatomical characters.

The work is illustrated by 378 text-figures, of which about 150 are original and new.

Recent monographs have contributed several which thus appear for the first time in a text-book (Ex. Figs. 120, 139, 160, 161). Among the new figures there are some exceptionally clear diagrams, such as Figs. 35, 61, 62, 110, and a series illustrating the relationship of the various cavities of the body (Figs. 111, 127, etc.).

At places where we are accustomed to meet certain time-worn figures there is some relief in finding either a new object employed or,

at least, new figures representing the old object (Ex. Figs. 4, 6, 116, 118, 140).

There is a small number of the inevitable verbal errors, of which may be noted: *foramen lacerus anterior* (p. 164), Fascia used as a plural (p. 112), and Malapterus (p. 115).

A New Text-Book on the Nervous System. — No field of zoölogical research has been more assiduously cultivated or has yielded more important results in the last decade than the nervous system. While the cell theory and the interpretation of most tissues in conformity with it are matters of history, the conception of the nervous system as an association of cells dates really from 1891. With the enunciation of the neurone theory by Waldeyer in that year, a new era in the study of the nervous system began; and though this theory may require modification even in some fundamental respects, it has been undoubtedly a most important factor in bringing order into what was neurological chaos. The result of this clarifying influence has been, not only an enormous productivity in effective research, but the appearance of several high-grade text-books dealing with the nervous system from the new standpoint. Ramon y Cajal's well-known brochure heads the list as the first consistent attempt to describe the nervous system of the higher animals as an aggregate of neurones. The same principle was adopted in van Gehuchten's text-book, and to a less extent in the more conservative treatises by Edinger and by von Lenhossék, and is accepted by the well-known American neurologist, L. F. Barker, in his new text-book entitled *The Nervous System and its Constituent Neurones.*[1]

The book, though divided into six sections, which are further subdivided into chapters, falls naturally into two parts: the first, comprising the first five sections of a little over 300 pages, contains a general account of the structure and physiology of the nervous unit or neurone; and the second, including only the sixth section of some 650 pages, presents a descriptive account of the groups of neurones constituting the nervous system of man and other higher mammals.

To the general reader the first five sections are naturally the more interesting. The first section is given to an historical account of the development of the neurone concept. This opens with a description

[1] Barker, L. F. *The Nervous System and its Constituent Neurones*, designed for the Use of Practitioners of Medicine and of Students of Medicine and Psychology. New York, Appleton & Co. xxxii + 1122 pp., 676 illustrations, and 2 colored plates.

of the diffuse nervous network, supposed by Gerlach to be the means of communication between the nervous elements, and is followed by an account of the discoveries made chiefly by the Golgi and the Ehrlich methods, whereby investigators were led to abandon Gerlach's views. By this course the reader is led up to the full statement of the neurone theory by Waldeyer in 1891. The concluding chapter of this section deals with the objections which have been raised to the theory since its promulgation. The foundations of the theory are fourfold: first, it is *a priori* probable that the nervous system, like other parts of the body, is a cellular system; secondly, it is well established that the embryonic nerve cells are as distinct from one another in the beginning as any other cells; thirdly, the nutrition of the nervous elements, as shown in their degeneration, etc., is most readily understood on the grounds of this theory; and, fourthly, the selective staining of elements as seen in Golgi and in Ehrlich preparations accords well with this view. The objections raised against the theory are regarded by the author as relatively slight. The union of nerve cells through their processes, as seen occasionally by observers such as Dogiel, is regarded as no more objection to the general theory than Siamese twins are to the idea that the human species is made up of separate individuals. The results of Apáthy's studies, according to which a network much as Gerlach believed in is claimed to exist, are stamped with "Not proved"; and the author states that even should they prove true they afford no grounds for a serious criticism of the theory.

The second section deals with the external morphology of the neurone. The classification of cell processes into axones and dendrites is generally accepted, and only a hint is now and then given that the conditions in the lower animals show that this distinction is one of a very questionable nature and certainly not fundamental. The interrelation of neurones through contact only and the so-called "retraction theory," so much in vogue with certain classes of psychologists, are put in their true light as a matter of great uncertainty.

The third section, on the internal morphology of the neurone, is a masterful presentation of one of the most confused and intricate problems of neurology. The interpretation of conflicting results on the basis of differences in methods and the sweeping away of difficulties arising from a confusion in terminology are admirable features of this part of the work. In one respect only is the author less happy in his treatment of the subject. He expresses the belief that many of the problems of the finer anatomy of nerve cells must wait for

solution till more definite knowledge can be gained of the structure of cells in general. To us it seems that the nerve cell is one of the best cells in which these problems can be attacked.

The section on the histogenesis of nerve tissue is less satisfactory than any of the preceding, because too little is given on histogenesis and too much on the topographical development of the vertebrate nervous system. The subject of the development of nerve fibres is only touched, and the differentiation of the various forms of nerve cells receives little attention. A very full account of the segmental arrangement of the spinal nerves and their relation to the musculature is given.

The physiological and pathological aspect of the neurone is treated in the fifth section. The metabolism of the nerve cell, as illustrated by the degeneration of its fibres when cut from it, is well described, and emphasis is justly laid on the lately discovered changes shown in cells from which fibres have been separated. The equally important subject of the regeneration of nerves is passed over with very few words. Reasons are brought forward to show that neurones in life are under slight but continuous stimulation, and that all parts of the neurone, including the dendrites, are more or less concerned with true nervous functions. The nature of nervous impulses is not discussed, but their directions so far as the cell body is concerned are shown to be not subject to such simple laws as have been formulated. This section concludes with an excellent résumé of the visible effects of fatigue and poisons on nerve cells, and a brief consideration of the means by which the cell body influences the nutrition of the distant parts of its fibres.

The sixth section includes an exhaustive account of the groups of neurones making up the human nervous system. Its five subsections deal with the following groups: sensory neurones of the first order; sensory neurones of the second order; lower motor neurones; upper motor neurones; and projection, commissural, and association neurones.

While every student of neurology will be thankful to the author for the thoroughgoing way in which he has carried out his undertaking, and for the admirable clearness with which he has set down his results, the work is not without its faults. Chief among these is the very general absence of reference in the more introductory sections to the results of neurological study in the lower animals. While the comparative novelty of this field may be some excuse for its neglect, the part it has played in setting in a right light many of the general

problems which have arisen in the neurology of higher forms shows that one cannot afford to neglect it.

A second and perhaps less pardonable fault is the absolutely unqualified way in which the neurone theory is accepted and the light manner in which really serious objections to it are passed over. To read the author's presentation of Apáthy's work one would think that this investigator's results were almost in line with the neurone doctrine; but an unbiased comparison shows this not to be true. Surely the statements of Apáthy, if correct, are more serious obstacles to the acceptance of the neurone theory than Barker is willing to admit; and what is perhaps less consoling to an advocate of the theory is that these statements have received no small amount of confirmation at the hands of Bethe.

The letterpress and numerous illustrations are excellent, and the volume is provided with two indices — one for subjects and the other for authors. In the subject index the two kinds of type used in the page numbers refer, we are told, in one case to text and in the other to figure reference; in the author's index two kinds of type are also employed, but, probably through an oversight, no explanation of their use is given.

The defects which the book has are few compared with its excellencies, and we do not hesitate to pronounce it a masterly production of the highest quality of which Americans may justly be proud.

G. H. P.

Neurone Theory. — A very interesting and timely brochure on the neurone doctrine and its opponent has come from the pen of A. Hoche.[1] The author gives a clear statement of the foundations of the theory, and then considers it in the critical light of recent discovery. His conclusions are that the neurone theory in its original form is no longer tenable, and that the fibrillar theory must replace it, so far as the histology of the adult nervous elements is concerned. The nervous elements develop as independent cells, and become secondarily connected by fibrillar growths, though in this later condition they reassert their physiological independence in the various aspects of their metabolism. The histogenesis and physiology of nervous elements, particularly their trophic relations, follow then on the lines laid down by the neurone theory, and in these respects this theory may still be said to be valid.

G. H. P.

[1] Hoche, A. Die Neuronenlehre und ihre Gegner. 51 pp. A. Hirschwald, Berlin, 1899.

Polytomous Nerve Fibres. — Dr. E. Ballowitz[1] has found that the enormous electric nerve fibres of the electric catfish of the Nile, Malapterurus, do not branch as ordinary medullated fibres do, but divide at once into from four to nine trunks. The most usual numbers were five or seven, the even numbers, six and eight, being less frequent. The resulting fibres varied much in calibre, but were always thinner than the main fibre, which, however, was not so large in cross-section as the derived fibres taken collectively. A derived single fibre may branch again dichotomously or trichotomously, as ordinary fibres do. The condition shown in the division of the main fibre in Malapterurus is intermediate between that found in ordinary nerve fibres and in the electric ray, Torpedo, where the branches vary between fifteen and twenty-five.

G. H. P.

Nerve Cells of the Human Cortex. — Helen B. Thomson[2] has undertaken some interesting computations concerning the composition of the brain in man. She finds that the total number of functional nerve cells in the cerebral cortex of an adult man is in round numbers ninety-two hundred millions, and yet the volume of these is only 1.37% of the whole cortex. The number of giant cells in the cortex corresponds almost exactly with the number of pyramidal fibres passing to the spinal cord, and hence the pyramidal fibres are probably the processes of these cells.

G. H. P.

The Fur Seals and Fur Seal Islands. — The third volume of the voluminous report on the Fur Seal and the Fur Seal Islands, by Dr. David Starr Jordan and his associates, is just issued from the Government Printing Office. The first two volumes, issued some time since, relate to The Fur Seal of the Pribilof Islands : its History, its Natural History, and its Fate. The fourth volume, already issued, consists of Dr. Leonhard Stejneger's report on The Fur Seal Islands of Russia and Japan.

The present volume is due to the enlightened interest of Mr. Charles Sumner Hamlin, then Assistant Secretary of the Treasury, who instructed the Commission to use all possible effort to complete our knowledge of the fauna and flora of the regions visited.

The present volume of 630 quarto pages is devoted almost entirely

[1] Ballowitz, E. Ueber polytome Nervenfaserteilung, *Anat. Anzeiger*, Bd. xvi, pp. 541–546.

[2] Thomson, H. B. The Total Number of Functional Cells in the Cerebral Cortex of Man, etc., *Journ. of Comp. Neurology*, vol. ix, pp. 113–140.

to the natural history of Bering Sea. It was prepared under Dr. Jordan's direction, under the editorial supervision of Mr. Frederic A. Lucas. It contains the following articles, most of them fully illustrated:

1. "The Main Divisions of the Pinnipedia," by Mr. Lucas. In this paper the distinctions between the Otariidea, or eared seals (with the walrus), and the Phocoidea, or true seals, are fully developed.

2. "The Species of Callorhinus, or Northern Fur Seal," by Dr. Jordan and Mr. George A. Clark, Secretary to the Commission. In this paper three closely related species or subspecies are indicated and named, corresponding to the three well-known herds. These are *Callorhinus ursinus* (*L*), the fur seal of Komandorski, *Callorhinus alascanus*, the fur seal of the Pribilofs, and *Callorhinus curilensis*, the fur seal of Robben Island and the Kuriles. As the differences are slight, these may well be regarded as subspecies, but from the nature of things they do not intergrade. The generic name Callorhinus is retained as sufficiently distinct from the earlier Callorhina, the two words being spelled differently. Those who hold otherwise may call the fur seal Callotaria Palmer.

3. "Variations in Size and Color of the Fur Seal," by Mr. Lucas.

4. "Dentition of the Fur Seal," by Mr. Lucas.

5. "Anatomy of the Fur Seal," by Robert E. Snodgrass.

6. "Brain of the Fur Seal," by Dr. Pierre A. Fish.

7. "Breeding Habits of the Fur Seal," by Mr. Lucas.

8. "Food of the Fur Seal," by Mr. Lucas. This is shown to consist mainly of the seal-fish (*Therobromus callorhini*), a species of smelt hitherto undescribed, of the Alaskan pollock (*Theragra chalcogramma*), and of a squid (*Gonatus amœnus*). Practically no species available as human food are commonly eaten by the fur seal.

9. "Mental Traits of the Fur Seal," by Mr. Lucas.

10. "Causes of Mortality among Fur Seals," by Mr. Lucas.

11. "Internal Parasites of the Fur Seal," by Charles Wardell Stiles and Albert Hassall. Of these the most important is the strongyle worm, Uncinaria, which destroys large numbers of the seal pups on the sandy rookeries on St. Paul. The eggs of this worm lie in the sand, adhere to the fur of the mother, and are swallowed by the young. Most of the rookery ground is rocky, but on sandy tracts, as on parts of Tolstoi and Zapadni rookeries, the mortality is very great, the pups affected dying of anæmia. In this paper fourteen species of Ascaris are described besides the Uncinaria and a small tapeworm.

12. "The Beasts of the Sea," a translation from Steller's original account by Professor Walter Miller. This remarkable work (De Bestiis Marinis), published in 1751, gives the first account of the sea cow, the sea otter, sea lion, and sea bear, or fur seal.

13. "The Sea Bear," a translation of an essay by Bishop Ivan Veniaminof, 1839, by Dr. Leonhard Stejneger.

14. "Pelagic Sealing," by Charles H. Townsend, a valuable collection of observations and records.

15. "Notes on the Fur Seals of Guadalupe, Galapagos, and Lobos Islands," by Mr. Townsend. This article and the preceding are illustrated by excellent photographs.

16. "Descriptions of the Guadalupe Seal, Arctocephalus townsendi," by Dr. C. Hart Merriam.

17. "Ecology of Guadalupe Island," by Dr. Wilbur W. Thoburn.

18. "Insects of Guadalupe," by William A. Snow.

19. "Plants of Guadalupe," by Professor William Russell Dudley. One new species, *Talinum guadalupense*, is described.

20. "Cruise of the *Dora Siewerd*" (sealing schooner), by A. B. Alexander.

21. "Fur-Seal Hunting in the Southern Hemisphere," by Dr. J. A. Allen.

22. "Rookery Maps of the Pribilof Islands," by Lieut.-Comm. J. F. Moses, U. S. N.

23. "Branding of Seals," by Dr. Jordan and Mr. Clark.

24. "Electrical Branding," by Elmer E. Farmer.

25. "Branding Experiments on St. Paul," by Colonel Joseph Murray.

26. "Branding Experiments on St. George," by Mr. James Judge.

27. "The Blue Fox (*Vulpes lagopus*)," by Dr. Jordan and Mr. Clark.

28. "Mammals of the Pribilof Islands," by Frederick W. True.

29. "Birds of the Pribilof Islands," by William Palmer. Sixty-nine species enumerated, with valuable notes and plates.

30. "Fishes of Bering Sea," by Dr. Jordan and Dr. Chas. H. Gilbert. Two hundred and twenty-nine species enumerated, with notes and numerous plates. The numerous species are all included in Jordan and Evermann's "Fishes of North and Middle America."

31. "Fishes of Arctic Alaska," by Norman B. Schofield. Notes on thirty-eight species, two, *Argyrosomus alascanus* and *Liparis herschelinus*, being new.

32. "Tunicates of the Pribilof Islands," by Dr. William E. Ritter. Eleven species described and figured, ten being new. These are *Styela greeleyi*, *Dendrodoa tuberculata* and *D. subpedunculata*, *Polyclinum globosum* and *P. pannosum*, *Aplidiopsis jordani*, *Amaroucium kincaidi*, *A. pribilovense*, and *A. snodgrassi*, and *Synoicum irregulare*.

33. "Mollusks of the Pribilof Islands," by Dr. William H. Dall.

34. "Insects of the Pribilof Islands," by E. A. Schwartz.

Two seal ticks are described as new, *Hæmatopinus callorhini* and *Ixodes arcticus*, in a supplemental note by Professor Herbert Osborn.

35. "Crustacea of the Pribilof Islands," by Mary J. Rathbun. *Crangon communis*, *Nectocrangon crassa*, *Spirontocaris barbata*, and *Spirontocaris avina* described as new.

36. "Plants of the Pribilof Islands," by James M. Macoun. With notes and plates.

37. "Algæ of the Pribilof Islands," by Dr. W. A. Setchell. Thirty-eight species noted.

Many of these papers deserve more extended notice or review, but this note may serve as an index to them. D. S. J.

Fishes of the Potomac River. — In the *United States Fish Commission Bulletin* for 1898, Dr. Hugh M. Smith and Mr. Barton A. Bean give a valuable list of the fishes found in the waters of the District of Columbia, with notes on their distribution. Eighty-one species are enumerated. D. S. J.

The Reappearance of the Tilefish. — In May, 1879, Captain Kirby, of Gloucester, discovered in the deep waters south of Nantucket a very remarkable fish, brilliantly colored and of high value as food. This fish was described by Goode and Bean as *Lopholatilus chamæleonticeps*, and the common name of the tilefish was suggested by Dr. Goode. This name alludes to its tile-like coloration, being also an available syllable of Lopholatilus, its scientific name. In 1882 vast numbers of tilefish were killed by a cold storm, and were found floating in the Gulf Stream. Since that time the species has not been seen until 1897 and 1898. The explorations of the Grampus under the auspices of the United States Fish Commission show that the species now occupies its original range, having recovered from the partial extermination of 1882. A full record of these investigations is given by Dr. Hermon C. Bumpus in the *Bulletin of the United States Fish Commission* for 1898. D. S. J.

The Nervous System of the Bony Fishes. — Dr. C. Judson Herrick, of Denison University, contributes to the *Bulletin of the United States Fish Commission* for 1898 a valuable study of the peripheral nervous system in bony fishes. D. S. J.

A Filefish New to the United States. — Dr. Hugh M. Smith, in the *Bulletin of the United States Fish Commission* for 1898, describes and figures a species of filefish new to the waters of the United States, and which he refers to *Alutera monoceros*, a species of the Indian Ocean and tropical Pacific. The specimen was taken at Woods Holl by Mr. Vinal N. Edwards, and is evidently like so many others found in this locality, a straggler brought from the West Indies by the Gulf Stream.

Fishes now referred to *Alutera monoceros* have been described under very many different names, and it is highly probable that more than one species is included under this title. A species of this type has been described by Poey, from Cuba, under the name of *Alutera güntherina*. The latter species has not been since seen. It is scantily described, and if words and plates can be trusted, it differs from Dr. Smith's fish in the higher spine and truncate caudal fin. It is probably not the same species, in which case two species of short-tailed Alutera exist in our waters besides the long-tailed *Alutera schœpfi*, *punctata*, and *scripta*. In any event this species is an interesting addition to our fauna, whether it be *Alutera monoceros* or a species distinct. D. S. J.

Fishes of Kadiak Island. — Mr. Cloudsley Rutter, now assistant to the United States Fish Commission, made in May, 1897, a fine collection of the tide-pool fishes in the vicinity of Karluk. This collection is described in the *Bulletin of the United States Fish Commission* for 1898. Fourteen species are enumerated, two of which are new, besides a third, *Neoliparis rutteri*, described as new by Gilbert and Snyder in Jordan and Gilbert's "Fishes of North and Middle America." The new species, which are well figured, are *Sigmistes caulias* and *Porocottus bradfordi*. Sigmistes is a new genus allied to Oligocottus, with a smooth body, arched lateral line, and very long dorsal. The single preopercular spine is hooked upward. D. S. J.

Fishes of the Congo. — Dr. G. A. Boulenger, of the British Museum, has issued the fourth fascicle on new fishes of the Congo, containing species of Polypteridæ, Clupeidæ, Mormyridæ, and Characinidæ, with detailed descriptions and excellent plates. D. S. J.

Fishes of Florida. — In the *Report of the United States Fish Commission* for 1899, Dr. B. W. Evermann and Dr. W. C. Kendall give a check list of the fishes of Florida, with references to all notices of the localities of each species, and also a complete bibliography. Five hundred and seventy-six species are enumerated, which shows the thoroughness with which that interesting region has been explored. The paper furnishes an admirable model as a faunal catalogue, and it has great value to the student of geographical distribution. D. S. J.

Günther on the Fish Collections of Linnæus. — The account of the fishes, as given by Linnæus in the *Systema Naturæ*, is based

almost solely on the writings of other authors, notably those of his associate and close friend, Peter Artedi, the "father of ichthyology." There was, however, in Linnæus's possession a small collection of fish skins, the most important of these containing seventy-one species, having been sent from Charleston, South Carolina, by Dr. Alexander Garden.

Most of this collection is now preserved in the Collection of the Linnæan Society of London. Dr. Albert Günther, president of this society, in a recent address, has given an account of each of these specimens. This account is in greater detail than one given in 1886 by Messrs. Goode and Bean, and some of its conclusions have an important bearing on the nomenclature of North American fishes.

The examinations of Dr. Günther necessitate the following changes from the names lately accepted by Jordan and Evermann: *Felichthys felis* (Linnæus) for the Gaff topsail catfish, instead of *Ailurichthys marinus* (Mitchill); *Galeichthys milberti* (Cuv. and Val.), instead of *G. felis;* if Dr. Günther's identification of *Siluris felis* is correct, which we cannot doubt, it is strange that Linnæus counted six barbels when but four exist; *Epinephelus guttatus* (Linnæus), instead of *E. maculosus* Cuv. and Val. (*lunulatus*, *apua*, and *catus* of authors); *Promicrops itaiara* (Lichtenstein), instead of *P. guttatus.*

Dr. Günther shows that in forming his complex *Perca guttata*, Linnæus had a specimen in hand from which his color notes were drawn. Excluding erroneous synonyms, this specimen may be regarded as the typical *P. guttata.* Dr. Günther notes that *Stellifer lanceolatus* has the downward directed spine of the subgenus Zestidium. He, however, wrongly identifies it with the type of the latter group, *S. illecebrosus*, from Panama. The two species differ notably in numbers of fin rays and gill rakers.

Besides these specimens, we may note that Dr. Einar Lönnberg has given a supplementary account of the Linnæan fishes in the University of Upsala. The original type of *Exocœtus volitans* is the flying fish called *Halocypselus evolans*, as indeed the description indicates. Exocœtus is therefore the right name for the group of flying fishes having short ventrals, the Halocypselus of Weinland, while the name Cypselurus of Swainson is revived for the large flying fishes.

D. S. J.

Meek on the Fishes of Lake Muskoka. — In the publications of the Field Columbian Museum of Chicago, Dr. Seth E. Meek has notes on the fishes of Lake Muskoka at Gravenhurst, Ontario. One

new species, *Notropis muskoka*, is described. This species is of the subgenus Chriope, an ally of *N. cayuga*. *Etheostoma boreale*, described by Jordan from Montreal in 1884, and not since seen, has been rediscovered by Dr. Meek in Gull Lake, near Lake Muskoka. D. S. J.

Function of Vascular Ampullæ in Composite Tunicates. — The colonial blood vessels of the composite tunicates belonging to the family Botryllidæ often show a considerable number of terminal enlargements — the ampullæ. These are found almost anywhere within the colony, but are especially numerous along its edges. They have been regarded without much reason as developing zoöids, an opinion generally abandoned for several more recent views; namely, that they are reservoirs for blood, organs for the excretion of the test matrix, or for respiration. Dr. F. W. Bancroft[1] has shown that they normally execute coördinated pulsations, which continue, with some change in the coördination, after separation from the rest of the colony. The rhythm of the ampullar pulsations is not affected by the reversals of the hearts in the zoöids. The pulsations are very slow, and the contractile tissue seems to be a thin layer of pavement epithelium. Such coördination as the ampullæ show is brought about principally by blood pressure. In an æstivating colony of *Botrylloides gascoi*, the circulation was kept up almost entirely by the ampullæ. They must, therefore, be regarded as organs for the propulsion of the blood. G. H. P.

Sense Cells in the Integument of Worms. — L. Atherton[2] has made a study of the integument of the fresh-water worm Tubifex, with special reference to its nervous structures. The epidermis, beneath which there is no basement membrane, is usually a single layer of cells, produced apparently from the growing zone at the caudal end of the worm. Sensory cells of a spindle shape, or more swollen, occur isolated, in loose groups, or as well-defined clusters; externally they are provided with sensory bristles, and internally they give rise to nerve fibres, which extend to the central nervous organs. Isolated sensory cells are numerous over the caudal end, sparse over the middle trunk region, and numerous again over the anterior part, where they may bear more than a single sensory bristle. Loose

[1] Bancroft, F. W. A New Function of the Vascular Ampullæ in the Botryllidæ, *Zool. Anzeiger*, Bd. xxii, pp. 450–462.

[2] Atherton, L. The Epidermis of Tubifex rivulorum Lamarck, with Especial Reference to its Nervous Structures, *Anat. Anzeiger*, Bd. xvi, pp. 497–509.

groups of sensory cells are found on all regions of the body except the anterior end. Well-defined clusters are found only on the prostomium and first few segments.

G. H. P.

The Eyes of the Polyphemidæ. — The eyes of the family of minute crustaceans, the Polyphemidæ, have been the subject of careful investigation by Dr. O. Miltz.[1] The eyes are compound, and each retinal element or ommatidium is composed of two distal cells, forming part of the corneal hypodermis, of five cells forming the cone, of two supporting cells, and of a group of five retinular cells. The nerve fibres pass centrally from the retinular cells. The development, physiology, and biological significance of the eyes are considered.

G. H. P.

Zoölogical Notes. — An Uncinaria from a panther that died in the Königsberg Zoo has furnished Cohn (*Arch. de Parasitol.*, Vol. II, No. 1, pp. 5–22, 1899) with some important data on the life history of these forms and the injuries they produce. An introductory discussion clears up the synonymy and shows that three good species occur in the Felidæ. The form studied, *U. perniciosa*, was found abundantly in small, dark-colored nodules in the wall of the small intestine, each nodule containing a number of individuals, among which the females were more numerous. A histological study of these nodules showed that they always lay in the submucosa, which was enormously thickened at that point at the expense of the circular muscle layer, and that each opened into the intestinal lumen by a small pore at which the epithelium was inturned. Larvæ much like those of *U. duodenalis*, recently described by Looss, were numerous in the intestinal mucus, and a single older form was met between the villi. In the nodules, on the other hand, only sexually mature individuals were found, together with the eggs. Cohn outlines the life history as follows: There is no secondary host, but the larvæ are brought directly into the intestine of the primary host, and when they have reached a certain period of growth they invade the wall of the canal and cause there the growth of nodules. The results of other investigators are interpreted in the light of this work which conforms, moreover, to the conjecture of Railliet in the case of *Sclerostoma equinum*.

[1] Miltz, O. Das Auge der Polyphemiden, *Zoologica*, Bd. xi (1899), Lieferung 4, pp. 1–60, Taf. I–IV.

A new pelagic nemertine is described by Woodworth (*Bull. Mus. Comp. Zoöl.*, Vol. XXXV, No. 1, July, 1899). It was taken by the *Albatross* while trawling at a depth of 500 to 2000 fathoms in the Pacific Ocean, and differs from the forms obtained by the *Challenger* expedition in several important particulars which justify its inclusion in a new genus — Planktonemertes.

Metagenesis in the Coccidia and Hæmosporidia is the subject of a recent important résumé by Schaudinn (*Zool. Centralblatt*, Vol. VI, No. 22, pp. 765–783, October, 1899). The article is accompanied by an extensive bibliography of the subject.

Notes on some exotic species of ectoparasitic trematodes, recently published by S. Goto (*Journ. Sci. Coll. Imp. Univ.*, Tokyo, Japan, Vol. XII, No. 4, pp. 263–295, Pls. XX, XXI, 1899), include studies made in this country, chiefly at the Newport Marine Laboratory. A dozen species, seven of which are new, are described with care, numerous points in the synonymy cleared up, and many details of anatomical structure worked out. One new genus, Dionchus, was discovered which unites characters of the Gyrodactylidæ and Monocotylidæ. American students are fortunate in having such satisfactory descriptions and illustrations of native forms as those given here.

C. T. Simpson has given in the *Bulletin of the United States Fish Commission* for 1898 a readable and interesting account of the structure, habits, enemies, and commercial value of our fresh-water mussels.

No. 5 of the third volume of the *American Journal of Physiology* contains the following articles: "A Modified Soxhlet Apparatus for the Extraction of Fat from Liquids," by A. E. Taylor; "A New Form of Piston Recorder and Some of the Changes of the Volume of the Finger which it Records," by W. P. Lombard and W. B. Pillsbury; and "Secondary Rhythms of the Normal Human Heart," by W. P. Lombard and W. B. Pillsbury.

The first number of the *Biological Bulletin*, edited by the director and members of the staff of the Marine Biological Laboratory at Woods Holl, Mass., has appeared, and contains the following articles: "Some Relations between Nervous Tissue and Glandular Tissue in the Tunicata," by M. M. Metcalf; "Regeneration of Tissue composed of Parts of Two Species," by T. H. Morgan; "Dinophilus gardineri

(sp. nov.)," by A. Moore; "Some Muscinæ of North America," by G. de N. Hough; and "Experimental Studies upon Hydromedusæ," by C. W. Hargitt. Under the head of "Bibliography and Publication" is printed the second report of the English committee on these subjects.

BOTANY.

The Last Contribution from the U. S. National Herbarium[1] is one of the largest and best of this valuable series. It is chiefly written by Dr. J. N. Rose, and is largely devoted to the Mexican flora. The more noteworthy features are: (1) a proposed rearrangement of the suborder Agaveæ, in which eight genera are recognized, Manfreda is kept distinct from Agave, Bravoa is reduced to Polianthes, and a new genus, Pseudobravoa, is established; (2) a synopsis of the small but difficult leguminous genus Nissolia, in which thirteen species are recognized and figured; (3) partial keys to the Mexican and Central American species of Zanthoxylum, Turnera, and Clitoria; (4) a considerable series of critical notes on the Malvaceæ, in which *Anoda incarnata* H. B. K. and a nearly related new species are united in the reëstablished and undoubtedly valid genus Periptera; (5) a synopsis of the species of Waltheria and Cedrela ranging north of the Isthmus of Panama; (6) a key to the Mexican and Central American species of Thalictrum; (7) the characterization of many new and capitally illustrated Mexican species of various orders; (8) the description of Treleasea, a new genus of Commelynaceæ, with three species ranging from Texas southward into Mexico; (9) notes on useful plants of Mexico.

The last subject is treated under the following heads: cereals and vegetables, fruits, beverage plants, seasoning and flavoring plants, medicinal plants, soap plants, tanning and dye plants, fibre plants, brush and broom plants, fence and hedge plants. The illustrations, chiefly half-tones, are numerous, clear, and well chosen.

Regarding the systematic part of Dr. Rose's work, it may be said that it bears internal evidence of great care and good judgment. The copious and painstaking citation of literature and synonymy testifies to the excellence of the present bibliographical methods in the botanical work of the department of agriculture under Mr. Coville's direction. The economic portions of the paper have

[1] Vol. v, No. 4, pp. 145–259, t. 18–64; issued Oct. 31, 1899.

unusual merit from the fact that the plants yielding the useful products are not named in the vague way too frequent in such discussions, but have been subjected to the critical identification of a systematic expert.

Besides the above-mentioned papers by Dr. Rose, the contribution contains a short article by Prof. L. F. Henderson, characterizing two new plants from Idaho, and another by Professor Coulter and Dr. Rose, describing and figuring an interesting new umbelliferous genus, Hesperogenia, from Mt. Rainier.

B. L. R.

Bailey's Botanizing.[1] — Under the title of *Botanizing*, Professor Bailey of Brown University has issued a revised and enlarged edition of *The Botanical Collector's Handbook*. Few of the methods taught are likely to lead to measurably poor results, though experience will teach profitable modifications of some of them to any boy with Yankee ideas, and most of the suggestions are likely to be worth many times the cost of the book to a beginner.

T.

Botanical Notes. — Important recent papers on seed anatomy are: Pammel, "The Histology of the Caryopsis and Endosperm of Some Grasses" (*Transactions Acad. Sci. of St. Louis*, VIII, No. 11); Pammel, "Anatomical Characters of the Seeds of Leguminosæ, chiefly Genera of Gray's *Manual*" (*loc. cit.*, IX, No. 6); and Schlotterbeck, "Developmental History of Important Seeds. The Anatomy of the Cotton Seed and the Development of its Seed Coats" (*Pharmaceutical Archives*, II, No. 11).

A catalogue of the spontaneous hybrids of the European flora, by E. G. Camus, is being published in current numbers of the *Journal de Botanique*.

The most important recent publication on American fossil plants is Professor Ward's "Cretaceous Formation of the Black Hills as indicated by the Fossil Plants," extracted from the *Nineteenth Report of the United States Geological Survey*. The paper is profusely illustrated, largely by reproductions of photographs made directly from the specimens.

In the advance sheets for December 19 of *Consular Reports*, Edward H. Thompson, United States Consul at Progreso, gives some interesting information concerning sisal fibre, from which it

[1] Bailey, W. W. *Botanizing*. A guide to field collecting and herbarium work. Providence, Preston & Rounds Co., 1899.

appears that the fibre of this Yucatan agave was first brought into considerable use between 1750 and 1780, though the first plantation was not established until 1848. The largest plantation to-day is said to be yielding about 375,000 pounds of cleaned fibre per month.

The Amoles, or saponifying plants, of Mexico are treated in Vol. III of *La Naturaleza*, by Dr. Manuel Urbina.

Mr. Gifford Pinchot, Forester of the United States Department of Agriculture, has published the first part of a primer of forestry as *Bulletin 24* of his Division. The book is clear, simple, well illustrated, and attractively gotten up.

Robert T. Hill's notes on the forest conditions of Porto Rico are published as *Bulletin 25* of the Division of Forestry of the Department of Agriculture. A number of photogravures illustrate the graining of the principal Porto Rican woods.

Persons who go to the Adirondacks will find useful a recently issued flora of North Elba, by Professor Peck. It is published as No. 28 of Vol. VI of the *Bulletin* of the New York State Museum, and may be bought for twenty cents.

A comparison of the floras of the alpine and temperate regions on the great Mexican volcanoes is published by Professor Heilprin in Vol. III of the Mexican journal *La Naturaleza.*

An interesting list of plants growing upon trees at Bad Nauheim, classified according to their means of dissemination, by Jaap, is to be found in the September–October number of the *Deutsche botanische Monatsschrift.*

Icones Selectæ Horti Thenensis is the title of a new serial, devoted to the plants flowering in the extensive collections of M. van der Bossche at Tirlemont, Belgium. The plates are drawn by D'Apreval, and accompanied by text by de Wildeman. The first fascicle appeared in September, 1899.

Draba, as represented in the West by the aurea stylosa forms, is analyzed by Heller in the December *Bulletin* of the Torrey Club, with the result that three species and one variety are described as new.

Some of the Canadian violets recently split off from what has passed current for *Viola cucullata*, are brought together by J. M. Dickson in the *Journal and Proceedings of the Hamilton Association for 1898–99.*

A chart showing the blossoming season of the wild-goose plum in 1898, published in *Farmers' Bulletin 103* of the Department of Agriculture, will be of interest to students of phenology.

Ten additional species of Sisyrinchium from the Southern States are described by Bicknell in the *Bulletin* of the Torrey Club for December.

Captain John Donnell Smith has recently distributed the fifth volume of his *Enumeratio Plantarum Guatemalensium*, etc., to which are appended, as heretofore, extra-prints of his later articles published in the *Botanical Gazette* descriptive of plants of this region.

The results of a biological survey of Mt. Shasta, California, are published by Dr. Merriam as No. 16 of *North American Fauna*. Though avowedly incomplete, his notes on the distribution of Shasta plants are of unusual value because of the detailed data given under each entry.

A catalogue of the ferns and flowering plants of South Dakota, by Professor Saunders, constitutes *Bulletin* 64 of the Agricultural Experiment Station of that state.

The second fascicle of *Icones Bogorienses*, published by the Buitenzorg Garden, deals with the Anonaceæ of that establishment, and is written by Dr. Boerlage.

Apropos of recent attempts to classify the species of Rosa on anatomical grounds, M. Crépin publishes some valuable generalizations in the thirty-seventh volume of the *Bulletin* of the Royal Botanic Society of Belgium.

A study of the Japanese lacquer tree, *Rhus vernicifera*, from the standpoint of morphology and anatomy, is reprinted by Dr. Möbius from the *Abhandlungen* of the Senckenbergische naturforschende Gesellschaft.

A very curiously fasciated plant of an unnamed species of Cotyledon is described and figured in a teratological paper by Gallardo in No. 4 of the *Comunicaciones* of the Buenos Aires Museo Nacional, recently issued.

Students of hybrid docks will be interested in a paper on the North European forms of the genus Rumex, by Murbeck, reprinted from *Botaniske Notiser* for 1899.

Professor V. M. Spalding's paper on the white pine (*Pinus strobus*), revised and enlarged by Professor Fernow, is published as *Bulletin* 22 of the United States Department of Agriculture.

A revision of the North American species of the genus Frullania, by Professor A. W. Evans, is published in Vol. X of the *Transactions* of the Connecticut Academy of Arts and Sciences.

Professor Macbride has done a useful piece of work in allowing his *Myxomycetes of Eastern Iowa* to expand into the handsome volume, *The North American Slime-Moulds*, just issued by The Macmillan Company — a volume which should be in every botanical library.

Students of kephir and similar ferments will find interest in a paper by H. Marshall Ward and J. Reynolds Green, on a sugar bacterium, reprinted from Vol. LXIV of the *Proceedings* of the Royal Society.

The October number of the *Queensland Agricultural Journal* contains a report on the timber trees of a district of North Queensland, by J. F. Bailey, which includes an annotated list of 111 species, several of which are figured.

"Forestry Notes for Iowa" is the title of a paper by Professor Macbride separately printed in advance from the tenth *Report* of the Iowa Geological Survey.

A preliminary catalogue of plants poisonous to stock, by V. K. Chesnut, is reprinted from the annual *Report* of the National Bureau of Animal Industry, for 1898.

The *Bulletin* of the Torrey Botanical Club for November contains papers on *Lycopodium complanatum* and *L. chamæcyparissus*, by F. E. Lloyd; the dichotomous Panicums, by G. V. Nash; *Delphinium carolinianum* and related species, by P. A. Rydberg; New and interesting plants from western North America, by A. A. Heller; A new genus of powdery mildews — Erysiphopsis, by B. D. Halsted; and The habitats of the Pellæas, by E. J. Hill.

Part I of the second volume of the *Contributions* from the botanical laboratory of the University of Pennsylvania contains nine papers, presenting the results of laboratory investigation in various fields of botany.

In 1879 Professor Beal buried seeds of twenty-two species of plants in the soil, in inverted bottles, and at the end of each period

of five years the viability of some of them has been tested. After twenty years in the soil, nine species, all common weeds, germinated, the percentage varying from 2 to 58, while thirteen species failed to grow, — as appears from a note in the September number of the *Journal* of the Columbus Horticultural Society.

From a recent article in *Gartenflora* it appears that at the great St. Petersburg botanical garden 24,176 species and varieties of plants are cultivated, the herbarium contains over a million and a half specimens, and the library consists of 14,040 works, bound in 27,588 volumes.

PALEONTOLOGY.

The Later Extinct Floras of North America.[1] — In the preface Dr. Hollick explains the conditions under which this posthumous work of Professor Newberry's was prepared for the press. An edition of twenty-five plates was issued without text in 1878, under the title, *Illustrations of Cretaceous and Tertiary Plants of the Western Territories of the United States.* Subsequently a revised edition of these, with forty-three additional plates, was printed, but not distributed, being withheld for the completion of the text. Professor Newberry's death stopped further progress on the work. Two sets of the plates bore manuscript names. From these plates, Professor Newberry's manuscript, the labels on type specimens, and Professor Newberry's previous publications, the present text was compiled. This was evidently a laborious undertaking carefully carried out, as evinced by the text and occasional editorial notes.

One hundred and seventy-four species are figured and are described in the text, with the exception of some species of which the editor found no manuscript or other descriptions by Professor Newberry. The plates are beautifully executed. The species described are all from the Cretaceous and Tertiary formations, and are from the Western States and Territories, excepting *Sequoia gracillima*, described as also from New Jersey, and *Salix membranacea*, described from New Jersey only. Six new species are described, namely, *Abietites cretacea*, *Sabal grandifolia*, *Myrica* (?) *trifoliata*, *Salix foliosa*,

[1] Newberry, John Strong. *The Later Extinct Floras of North America*, a posthumous work, edited by Arthur Hollick. Monograph of the U. S. Geological Survey, vol. xxxv, pp. i–xvii, 1–295, Pls. I–LXVIII. Washington, 1898.

Alnus serrulata fossilis, and *Magnolia elliptica*. A few new names or new combinations occur due to the necessities of nomenclature or corrections in generic reference. Many of Professor Newberry's species are figured for the first time. An important feature is the figures of several specimens which are the originals of tracings sent to Professor Heer, and from which that author published new species. These are *Populus litigiosa*, *Leguminosites marcouanus*, *Sapotacites haydenii*, and *Phyllites obcordatus*. In a table is given a list of localities from which specimens came as mentioned in the text.

It is most desirable in publication to state in what museums specimens described are located, and the absence of such information in this volume is an unfortunate omission. The undesirable tendency to consider species as distinct, simply because they occur in different geological horizons, is shown in several places, as under *Salix meekii* Newberry, of the Dakota Group, Cretaceous, where the author says that this species has a resemblance to several Tertiary species, "... from which it might be unwise to regard it as distinct if they were from the same formation." Similarly it is undesirable to give a separate name to fossils when their characters are so close to living forms that they are systematically indistinguishable. Cases in which this is done are *Onoclea sensibilis fossilis*, *Corylus rostrata fossilis*, *Alnus serrulata fossilis*. The description of fossil forms "indistinguishable" from living forms, as stated in several cases, raises an objection to the title of the volume, *The Later Extinct Floras of North America*. Species of fossil plants, as of fossil animals, should be based on the characters they present, independently of how long they may have lived, as represented by the lapse of geological time.

R. T. J.

Coal Measure Plants.[1]— In the course of publications by Williamson, Scott, Seward, and others, frequent reference has been made to the Binney collection of fossil plants which was presented to the Woodwardian Museum at Cambridge, England, in 1892. Although some of the species have been repeatedly investigated during the last few decades, the collection embraces other species which illustrate important morphological points hitherto overlooked, and thus afford valuable evidence of a phylogenetic character. Mr. Seward has undertaken to indicate the nature of the data he has gathered from the collection, and thereby places in the hands of working paleo-

[1] Seward, A. C. Notes on the Binney Collection of Coal Measure Plants, *Proc. Cambridge Phil. Soc.*, vol. x, iii, pp. 137.

botanists a number of very essential facts. The present "Notes" deal with four specimens of *Lepidodendron harcourtii* and *Halonia regularis*, which the author regards as specifically identical; and with a new genus of Cycadofilices to which he assigns the name of Megaloxylon, as represented by a single species, *M. scottii.*

D. P. P.

Matonia pectinata.[1] — In an important contribution to the *Philosophical Transactions of the Royal Society*, which gives evidence of the most searching care, Mr. Seward selects Matonia as representing an isolated type of ferns requiring further examination anatomically, in order to determine its relations to the Cyatheaceæ and Gleicheniaceæ, toward which it has been customary to assign it an intermediate position. Mr. Seward concludes that while the genus must hold an independent position among ferns, its affinities are most nearly with those of the Cyatheaceæ. His studies of existing species are designed to have a direct bearing upon the geological history of the Matonineæ, and he therefore brings into comparison Laccopteris and Matonidium in particular; from all of which he concludes that Matonia represents the survival of a family of ferns now confined to a few localities in Borneo and the Malay Peninsula, and represented by two living species, which in Mesozoic time had a wide geographical range, being especially abundant in the European area during the Jurassic and Lower Cretaceous times. The apparent absence of the Matonineæ from Tertiary formations suggests that these forms reached their maximum development in the Mesozoic, and that toward the close of the Cretaceous a decided restriction in geographical range had developed.

D. P. P.

Medullosa anglica.[2] — Dr. Scott's important contributions to our knowledge of the Cycadofilices have been recently enlarged by the description of a new species of Medullosa to which he assigns the name of *M. anglica.* He points to the fact that several genera such as Nœggerathia, Medullosa, Cladoxylon, Lyginodendron, Heterangium, and Protopytis are now to be grouped under Potonie's con-

[1] Seward, A. C. The Structure and Affinities of Matonia pectinata, R. Br., with Notes on the Geological History of the Matonineæ, *Phil. Trans. Roy. Soc.*, Ser. B, vol. cxci (1899), pp. 171.

[2] Scott, D. H. On the Structure and Affinities of Fossil Plants from the Palæozoic Rocks. III. Medullosa anglica, a new representative of the Cycadofilices, *Phil. Trans. Roy. Soc.*, Ser. B, vol. cxci (1899), pp. 81.

venient name of Cycadofilices; and also to the very important correlation of structures hitherto regarded as representing distinct organisms, but now known to be different members of plants belonging to the genus Medullosa.

The specimens of *M. anglica* studied were obtained from the colliery at Hough Hill, Stalybridge, and are of exceptional interest, not only as "being the first recorded British specimens of the genus," but "also from their geological horizon, which is considerably more ancient than that of the continental Medulloseæ." They are at the same time the most complete examples of the genus hitherto studied, and they thus furnish most important data with respect to our knowledge of the entire group. Although lacking in some of the most important structural characters (the fructification), the material furnishes further and important additions to our knowledge of the filicoid origin of the cycads.

D. P. P.

NEWS.

We learn that the Zoölogical Society of Holland is preparing a series of synopses of the fauna of Holland, following somewhat after the style of the Keys now being published in this journal.

The *Plant World*, hitherto published by Willard Clute & Co. of Binghamton, N. Y., will be issued in future by the Plant World Co., Washington, D. C.

Dr. Elliott Coues, the well-known ornithologist and for some years an associate editor of the *American Naturalist*, died in Baltimore, December 25. He was born in Portsmouth, N. H., Sept. 9, 1842, was graduated in arts and medicine from the Columbian University at Washington, and served as assistant surgeon in the U. S. Army from 1862 to 1881. He taught anatomy and zoölogy in Norwich University, Columbian University, and the Virginia Agricultural College. He was best known for his works on birds, including his *Keys to North American Birds* (three editions), *Birds of the Colorado Valley*, *Birds of the Northwest*, *Ornithological Biography*, etc., in which are to be found some of the best sketches in the language. He also worked on mammals. During his later years he became enamored with theosophy and neglected scientific work.

Appointments: E. A. N. Arber, demonstrator in paleobotany in the University of Cambridge. — Dr. F. W. Bancroft, instructor in physiology in the University of California. — Dr. Edmond William Wace Carlier, professor of physiology in Mason College, Birmingham, England. — Dr. Dandler, privat docent for anatomy in the University of Vienna. — W. H. L. Duckworth, instructor in physical anthropology in the University of Cambridge. — Grafton Elliott-Smith, demonstrator of anatomy in the University of Cambridge. — Dr. Otto von Furth, privat docent for physiology in the University of Vienna. — Dr. Martin Heidenhain, professor extraordinary of anatomy in the University of Tübingen. — Dr. J. J. Jahn of Vienna, professor extraordinary of geology in the newly established technical school at Brünn, Austria. — Alfred Jentzsch, geologist at the Geological Landesanstalt in Berlin. — S. J. Korshinsky, director of the herbarium of the Academy of St. Petersburg. — Dr. Alfred Krolopp, assistant

professor of botany in the Agricultural School at Altenburg. — W. Leslie, director of the botanical gardens in Trinidad. — Mr. Loye H. Miller, professor of chemistry and natural history in Oahu College, Honolulu, Hawaiian Islands. — Dr. Thomas H. Montgomery, Jr., assistant professor of zoölogy in the University of Pennsylvania. — Dr. Erik Gottlieb Müller, professor of anatomy in the Karolinian Institute at Stockholm. — Dr. Bohumil Nemesch, privat docent for plant anatomy and physiology in the Bohemian University at Prag. — James Louis North, keeper of the Museum of the Royal Botanical Society in London. — Professor Edward Orton, state geologist of Ohio, in succession to his father, the late Edward Orton. — Professor Picart of Bordeaux, professor of anatomy in the University at Lille, France. — Dr. Gustav Piotrowski, professor extraordinary of physiology in the Veterinary School at Lemberg. — Dr. Mat. Semper, privat docent for anatomy in the Technical School at Aachen. — Dr. E. O. Sisson, director of the histological laboratory at Keokuk, Iowa. — Dr. Velich, privat docent for animal physiology and pathology in the Bohemian University at Prag. — Nikolaus Warpachowsky of St. Petersburg, director of fisheries for the district of Archangel. — Dr. Wedekind, privat docent for natural science in the University of Tübingen.

Deaths: Dr. Christian Brügger, naturalist and director of the museum in Chur, Switzerland, in October, aged 66. — Dr. Deike, paleontologist, in Mülheim. — Professor Theodor Ebert, geologist of the Geological Landesanstalt in Berlin, in September, aged 42. — Nikolaus W. Grigorjeff, a young phytopaleontologist in the government of Charkoff, Russia, drowned July 16. — Dr. Ragnar Hult, botanist, and docent in geography in the University of Helsingfors, September 25, aged 42. — Dr. Matts Adolf Lindblad, formerly docent for botany in the University of Upsala, June 30, aged 78. — Hippolyte Lucas, assistant in entomology in the Paris Museum, September 29. — Dr. Josef Majer, formerly professor of anatomy in the University of Cracow, July 3, aged 91. — Dr. Geza von Mihálovics, professor of anatomy and embryology in the University of Budapesth, aged 55. — Michael Iwan Pylajeff, a Russian mineralogist, Feb. 3, 1899, aged 57. — Georg Ruscheweyh, lepidopterologist in Buenos Aires, August 2, aged 72. — George, Baron Schilling von Canstatt, ornithologist, in Scutari, Albania. — Dr. Adolf Schmidt, diatom student, in Aschersleben, Germany. — Christian Schwemmer, botanist, at Nürnberg. — Dr. Arthur Cowell Stark, ornithologist,

killed by a shell, November 18, at Ladysmith, South Africa. — Siegfried Stauffer, founder of the natural history museum in Luzern, August 3. — Samuel Stevens, entomologist and formerly a large natural history dealer in London, August 29, aged 82. — Friedrich Stolz, student of cryptogamic botany, killed by a fall in the Tyrol, August 14, aged 21. — Dr. Carl Gustav Thompson, student of Hymenoptera and custodian of the entomological collections at Lund, Sweden, in September, aged 72. — Dr. Stephen Baron von Washington, ornithologist, at Pols, Styria, September 9, aged 41. — Rev. William Farren White, entomologist, at Bournemouth, England, July 21, aged 65. — George Buchanan Wollaston, student of ferns, at Clapham, England, March 26, aged 85. — Frederik Mauritz van der Wulp, student of the Diptera, at The Hague, aged 80. — Professor R. Yatube, botanist, in Japan. — John Bridgman, English entomologist, October 6, aged 63.

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